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Division of Agriculture.

ANNUAL REPORT FOR 1928.

STAFF.

Mr. B. Bunting, Agriculturist, was in charge of the Division throughout the year. Mr. J. Lambourne, Assistant Agriculturist, returned from leave and resumed duty at the Experimental Plantation, Kuala Lumpur, on the 8th March. Mr. J. N. Milsum, Assistant Agriculturist, proceeded on leave on the 6th April. Mr. J. L. Greig was appointed an Assistant Agriculturist and assumed duty at the Experimental Plantation, Serdang on the 15th November. Mr. F. S. Banfield, Horticultural Assistant, was transferred from the Experimental Plantation, Serdang to Maxwell's Hill Gardens, Taiping on the 27th December.

EXPENDITURE AND REVENUE.

The total expenditure incurred on the Experimental Plantations during the year under review was $135,829.89, while the revenue from various sources over the same period amounted to $21,547.82.

EXPERIMENTAL PLANTATION, SERDANG.

Staff.—Mr. J. N. Milsum, Senior Assistant Agriculturist, was in charge of the plantation until he proceeded on leave on the 6th April, when Mr. T. D. Marsh, Assistant Agriculturist (West Division) acted in this capacity during the remainder of the year. Mr. E. A. Curtler, Assistant Agriculturist (East Division), was stationed on the plantation throughout the year, while Mr. J. L. Greig, who was

appointed an Assistant Agriculturist, assumed duty at Serdang on the 15th November and was stationed on the plantation during the remainder of the year.

Mr. F. S. Banfield, Horticultural Assistant, was also stationed on the plantation until the 27th December, when he was transferred to Maxwell's Hill Gardens, Taiping.

Development.—The development work on the plantation during the period under review has been mainly connected with the construction of roads and culverts.

The area now opened is approximately 800 acres, which includes a reserve of about 25 acres for the proposed Agricultural School and about 30 acres of roads and building sites, the balance of 745 acres being planted with various economic crops.

Planting Operations.—The following is a list of the more important crops which have been planted during the year:—

Tapioca varieties 18 acres, *Hydnocarpus anthelmintica* 17 acres, Tuba root (Derris) 15 acres, Sisal Hemp 7½ acres, Fruits (various) 7 acres, Brazil nut 5 acres, Oil palm varieties 3½ acres, *Taraktogenos Kurzii* 3 acres, Sugar cane 2 acres, Lemon grass 1½ acres, Cinnamon 1 acre, Manila hemp 1 acre and Palmyra palm 1 acre.

Fruit Nursery.—Considerable attention has been given to the propagation of native fruits and the nursery is now well-stocked with plants of various types of fruits.

Distribution of Planting Material.—The demand for different forms of planting material has increased considerably during the past year and large quantities of seeds and cuttings of various economic plants were forwarded to headquarters for distribution throughout the Peninsula.

The planting material mostly in demand included seeds of oil palm, coffee and cover plants, cuttings of sweet potatoes, tapioca and guinea grass and seedlings of local fruits

Introduction of Planting Material.—The following is a list of various forms of planting material introduced at Serdang during the year:—

Bud-grafts of Kapok were received from the Economic Gardens, Buitenzorg, Java.

Seeds of *Dolichos falcatus* syn. *D. labialis* and *Grevillea robusta* were received from the Department of Agriculture, Ceylon, *Elaeis guineensis* Diwakawaka or Ayara Mbana from the Director, Algemeen Proefstation, A.V.R.O.S., *Annona aquamosa*, *Inocarpus edulis*, *Dillenia philippinensis*, *D. rieffenscheidia*, *Sandoricum koetjape* and *Terminalia edulis* from the Bureau of Agriculture, Manila, *Hydnocarpus Wightiana* from Ernakalam, Malabar, South India and Kanara coast Division, Bombay, Jugo bean from S. Rhodesia, *Azadirachta indica* from India, Dangri Tea from Dibrugarh, Assam and *Tephrosia toxicaria* from the Director of Agriculture, British Guiana, through the Economic Botanist, Kew.

Labour.—In compliance with instructions from Government the minimum wage for able-bodied labourers was raised to 50 cents per day for men and 40 cents per day for women as from the 1st. January. The working day was, however, extended by half an hour as from this date with satisfactory results.

A school was provided for the education of Tamil children resident on the plantation.

Health.—The general health of the labour force has been fairly good throughout the year, but the incidence of malaria was higher during the dry months.

A visiting Medical Officer attends the plantation fortnightly for a general inspection. A resident Dresser was stationed on the plantation as from the 19th October.

Buildings.—The following is a list of new buildings erected on the plantation during the year:—

Two Temporary Quarters for Subordinate Officers, 1 Dispensary, 1 School and Creche, 1 Creche, 3 Kitchens (5 rooms), 2 Latrines and 2 Incinerators.

Experimental Work.—The experiment started last year with the object of ascertaining the optimum period between harvesting the leaves of sisal hemp, which is being carried out in collaboration with the Agricultural Chemist, was continued.

A similar experiment with gambier, which is also being carried out in collaboration with the Agricultural Chemist, regarding the effect of harvesting the fresh leaves at intervals of 3, 4 and 6 months respectively, has also been continued.

An experiment was carried out during the year on an area of 4 acres to test the effect of harvesting "tuba puteh", a variety of *Derris elliptica*, at intervals of 21, 23, 25 and 27 months from date of planting on both the yield and toxicity of the sun-dried root. Representative samples of (a) fine roots and (b) thick roots from each plot were submitted to the Agricultural Chemist for analysis and determination of toxicity.

A further experiment of harvesting "tuba erect", a variety of *Derris malaccensis*, at different intervals on the same lines as that carried out with "tuba puteh" has been started, but in this case the root will be harvested at intervals of 19, 21, 23, 25 and 27 months respectively.

An experiment with oil palms has been laid down in Block 2 to ascertain the effect of cutting out all female inflorescences on palms up to four years old from planting in the field.

The observations will include (a) rate of growth and (b) whether the treatment has a stimulating effect by causing the production of an abnormal number of female inflorescences.

A further series of experiments was started on the oil palms in Block 21 in which the following investigations are being undertaken:—

(1) A block of 95 palms are being kept under close observation and individual yields recorded.

(2) A pollination experiment, of approximately four acres, has been started. One set of sixty three palms has six female inflorescences artificially pollinated per annum, another set of the same size twelve per palm, a third set has all female inflorescences artificially pollinated, while a fourth set is retained as a control, on which no artificial pollination is practised.

(3) A preliminary experiment, also about four acres in extent, has been started to compare the effect of "normal"

pruning with "minimum" pruning, alternate rows throughout the area receiving one of the methods. "Normal" pruning consists of cutting off all leaves up to but exclusive of those with fruit bunches in their axils, each leaf being cut off at the same time as the bunch in its axil is harvested, this is the usual estate practice in Malaya. "Minimum" pruning consists of removing only such leaves as have turned yellow, this is the method now considered to be the more desirable.

Experiments have also been started in connection with the breeding of improved strains of oil palms by bagging the female inflorescences of ten of the highest yielding palms recorded during the past four years.

Arrangements were made to commence taking preliminary records of the individual yields of 120 oil palms in Block 21 at the beginning of 1929 with a view to carrying out manurial experiments later.

The observations which are being made on oil palms in the main avenue on the plantation were continued. The results of these observations are published periodically in the Malayan Agricultural Journal.

An experiment was carried out in connection with the harvesting of vetiver grass plots, which are arranged to determine the yield of roots at different planting distances. These plots were harvested at fortnightly intervals for a period of 3 to 6 months and samples of the sun-dried roots were submitted to the Agricultural Chemist for analysis in order to test the variation in oil content of root harvested at different periods of growth.

Other experimental work carried out during the year included (a) the effect of the cultivation of tapioca with regard to soil exhaustion (b) variety trials with tapioca and coffee growing under various conditions and (c) the individual yields of *Hydnocarpus anthelmintica*, *H. Wightiana*, areca nuts and cloves.

Stock Farm.—The stock farm at Serdang was further augmented during the year by the introduction of 4 pure-bred Montgomery incalf cows and 1 pure bred Montgomery bull from the Imperial Department of Agriculture, Pusa. These dairy cattle were received from India at the end of

December and within a few days of arrival one of the cows gave birth to a pure-bred bull calf. The other three cows, having been covered with a pure-bred Ayrshire bull, will eventually produce Ayrshire-Montgomery calves and it will be interesting to note how these cross-bred calves will thrive under local climatic conditions.

The following is a complete list of dairy herd at Serdang at the end of the year:—

1 Montgomery bull (aged), 1 Montgomery bull (imported), 8 Montgomery cows, 1 heifer (3 years), 3 Montgomery bulls (2½ to 3 years), 3 Montgomery heifers (1½ years), 3 Montgomery bull calves, 2 Ayrshire heifers (1½ to 2 years) and 1 Jersey bull (2 years).

The conditions at Serdang apparently suit the Montgomery breed of cattle and both young and old stock appear to thrive well on the plains in this country.

The pure-bred Ayrshire and Jersey stock are not so well suited for the plains in Malaya, but crosses of these breeds with the Montgomery stock will probably prove more suited to such conditions.

An area of about 20 acres of land reserved for the cattle farm has been cleared of timber and planted up with various grasses for grazing purposes.

A further supply of pure-bred Large Black and pure-bred Middle White pigs has been ordered from the Hong Kong Dairy Farm for carrying out pig-breeding experiments at Serdang.

Meteorological Observations.—Rain fell on 146 days during the year, giving a total rainfall of 105.48 inches, which is an increase of 7.91 inches on the previous year. The driest month during the year was June with a precipitation of 2.06 inches and the wettest month was October with a precipitation of 22.21 inches.

The mean maximum temperature during the year was 91.3 F (highest maximum 94.0 F) and the mean minimum 70.8 F (lowest minimum 68.0 F).

EXPERIMENTAL PLANTATION, CAMERON'S HIGHLANDS.

Staff.—Mr. J. P. K. Wilkins, Superintendent, remained in charge throughout the year.

Situation.—This plantation is situated at Tanah Rata in the south-eastern corner of the Highlands and has a mean elevation of about 4,750 feet above sea-level.

Development.—The area of 76 acres previously felled and partially cleared of timber has been gradually developed and at the end of the year about 50 acres of this area had been stumped and terraced ready for planting.

Plant Introductions.—The following is a list of planting material introduced during the past year:—

Seed of Betjan, Dhonjan, Rajghur and Dangri tea from Dibrugarh, Assam, Mysore and Malabar varieties of Cardamoms, Kent's Arabica coffee from Mysore, Himalayan raspberry from the Royal Botanic Gardens, Kew.

In addition various hill food crops, fruits, green manures and ornamental plants were established.

Nurseries.—The nursery area has been extended during the year to a little over 2 acres. The beds are well-stocked with planting material of numerous economic plants for trial on the Highlands and include about 50,000 tea seedlings and 10,000 Coffee arabica seedlings now ready for planting out in the field.

Planting Operations.—The following planting operations were carried out during the year :—

An area of about 5½ acres on the banks of the Bertam River were planted with various fodder grasses during April. An acre of Carpet grass, *Axonopus compressus*, was also planted out in May for grazing purposes.

Half an acre of *Cinchona Ledgeriana* and *C. succirubra* was planted at a distance of 4 ft. × 4 ft. in the open in May. A further 2 acres of *C. Ledgeriana* were planted at a distance of about 6 ft. × 6 ft. apart under light jungle shade during August/September.

An area of 3½ acres was planted with Arabian coffee.

An area of about 5½ acres was planted with Betjan (9,643 seedlings) and Dangri (4,532 seedlings), varieties of Assam tea.

Crops in the Field.—Of the major crops planted in the field a small plot of Assam tea, planted in January, 1926, continued to give satisfactory yields. The crop harvested from this plot between the 1st January and 31st December, 1928, amounted to 86 lbs. of dry tea. Since the area of this plot is only one-sixth of an acre this figure gives a calculated yield of approximately 516 lbs. of dry tea per acre per annum.

The Coffee arabica planted out in November, 1927, has shown excellent growth so far and appears to be particularly suited to the conditions on the Highlands.

Meteorological Observations.—Rain fell on 232 days during the year, giving a total rainfall of 83.39 inches as against 127.26 inches in 1927. The driest month during the year was January with a precipitation of 1.90 inches and the wettest month was December with a precipitation of 14.17 inches.

The mean maximum temperature during the year was 72.5 F. (highest maximum 79° F.) and the mean minimum 56.6° F. (lowest minimum 45° F.)

The total sunshine recorded was 1,637.85 hours for the year, which gives an average of 4.49 hours sunshine per diem, as against 4.0 hours during 1927.

Experimental Plantation, Kuala Lumpur.

Staff.—Mr. H. Ritchings, Horticultural Assistant, was in charge of this plantation until the 8th March, on which date Mr. J. Lambourne, Assistant Agriculturist, took over on return from leave and was in charge during the remainder of the year.

Maintenance.—The plantation was kept in good order throughout the year. Several sites on the plantation were handed over to the Public Works Department during the year for building purposes, which necessitated cutting out several mature areas of rubber.

Plant Introductions.—Seeds of *Tephrosia toxicaria* were received from the Director of Agriculture, British Guiana, through the Economic Botanist, Kew.

These seeds were planted at Kuala Lumpur at the end of July and the plants established have so far shown excellent growth. The roots of this plant contain a poisonous principle, somewhat similar to "tuba" root (*Derris*).

Experimental Work.—A number of nursery beds on the plantation were again allotted to the Economic Botanist for the purpose of carrying out selection work on several minor economic crops such as groundnuts, maize and soya beans.

The Mycologist was also given a small area for planting up plots of different varieties of bananas in connection with his investigations regarding Panama disease.

Small plots of various leguminous cover crops and green manures have been maintained in the nurseries for demonstration purposes.

Planting Material.—Attention was again given to the propagation of planting material for purposes of distribution.

General Agriculture.

A much greater interest has been taken throughout the year regarding the cultivation of crops other than rubber, which is undoubtedly due to the serious slump in the price of this important commodity. Judging by the large number of enquiries which have been received by the Division during the period under review in connection with the cultivation of such crops as oil palm, coffee, tea, pineapples, sisal and tuba root, far greater attention is being given to the possibility of establishing new agricultural industries in Malaya.

Coconuts.

The price of copra has again shown a slight reduction when compared with the previous year. The Singapore quotations show that the highest price for sun-dried copra was $12.00 per picul in January and the lowest $10.05 per picul in October, giving an average price of $10.92 per picul throughout the year, as against $11.17 per picul in 1927. The exports of copra from the Federated Malay States for

1928 amounted to 68,504 tons valued at $11,459,708/- as against 57,536 tons valued at $10,142,826/- in 1927.

Oil Palms.

Considerable activity has taken place during the past year in connection with the planting of oil palms and according to statistics collected departmentally it is estimated that the total area in Malaya planted with oil palms at the close of the year was approximately 24,730 acres, which shows an increase of about 5,000 acres over the area planted at the close of 1927.

The reserve land held by oil palm estates in British Malaya at the end of 1928 is estimated at about 27,000 acres, while an additional area of 25,000 acres represents alienations of land upon which planting operations have not yet commenced.

An experiment carried out at Serdang in collaboration with the Acting Agricultural Chemist to test the percentage of oil in oil palm fruits at varying stages of ripeness was completed. The results of these investigations show that there is a distinct loss of oil when unripe fruits are harvested and that only a fictitious increase of oil is obtained by storing the ripe fruits after harvesting owing to loss of moisture.

The price of oil palm products has remained very steady throughout the period under review and at the close of the year sales of palm oil were recorded at rates varying from £38 to £38-10 per ton, while the latest market reports indicate an advance in the price of this commodity during 1929. The price of palm kernels remains nominal at about £20 per ton, c.i.f. Liverpool.

The exports of palm oil products from the Federated Malay States during 1928 were 1,460 tons of palm oil, valued at $384,954/-, and 261 tons of palm kernels, valued at $43,475/-. The corresponding exports during 1927 were 852 tons of palm oil, valued at $269,966/-, and 178 tons of palm kernels, valued at $31,763/-.

Tapioca.

The experiments in the cultivation of tapioca, being carried out at Serdang in collaboration with the Agricultural Chemist, have been continued. A block of 10 acres reserved

for this purpose is sub-divided into 10 plots which receive different forms of treatment in order to ascertain the effect of continuous cropping on the yield of tapioca (a) without manuring, (b) with green manuring and (c) with artificial manuring.

The present prices of tapioca products are so low as to render the cultivation of this crop almost unremunerative.

Pineapples.

A number of introduced varieties of pineapples previously established at the Experimental Plantation, Serdang are now beginning to produce fruits so that it will soon be possible to make a general classification of the different types.

The export of canned pineapples from the Federated Malay States during the year was 3,688 tons, valued at $663,555/-, as against 3,968 tons valued at $822,719/- in 1927.

Coffee.

Considerably more attention is now being given to the cultivation of this crop and numerous enquiries have been received regarding the cultivation, on a small scale, of both the liberian and robusta varieties of coffee to meet the demands of the local markets.

Experiments with coffee planted on flat land, which are being carried out at Serdang, indicate that the coffee bushes thrive much better on clean weeded areas than when interplanted with some of the low-growing leguminous types of cover crops. Further, some form of light shade appears to be necessary in order to obtain the best results and for this purpose *Gliricidia maculata* is being given a trial.

At the present time there is very little raw coffee exported from this country and practically the whole of the produce is consumed locally. Generally speaking the liberian type is preferred to robusta on the local markets, consequently it usually commands a slightly higher price than robusta.

Tuba Root.

The investigations which are now being carried out at the Experimental Plantation, Serdang with several forms of tuba root (*Derris*) show that there are considerable variations

in the relative toxicity of the different varieties under cultivation, i.e.., the form known as "erect tuba", *Derris malaccensis*, has a much higher toxic content than that commonly known as "tuba puteh", *D. elliptica*. Further, the fine roots show a higher toxicity than the large roots in all cases.

The extended use of tuba root in the preparation of proprietary insecticides has been responsible for an increased demand of the raw product during the past year and ready sales of the air-dried root have been made locally at prices varying from 25 to 30 cents per lb., Straits currency

Sisal.

The results of experiments with sisal, carried out at Serdang, have shown that it is possible to produce a fibre of fair average quality.

The percentage of fibre extracted from the mature fresh leaves was 4.5 per cent., which may be considered very satisfactory.

Experiments in the harvesting of leaves at different intervals of growth are being continued, but so far the results do not show any great differences in either the quality or strength of the fibre whether the leaves are cut at intervals of 2, 4 or 6 months.

Areca Nuts.

A small experimental area at Serdang was planted with this crop in January, 1923 and commenced to fruit about the middle of 1926. Individual yields have been taken from about 1,500 palms comprising this area with a view to selecting a number of the highest yielders.

Observations have also been made on the proportion of dry split nuts to fresh fruit. The results from young palms show that the average proportion of split nuts to fruit was 25 per cent.

There has been a considerable decline in the exports of arecanuts during the past year as shown by the following figures:—

The export of arecanuts from the Federated Malay States during the year was 814 tons, valued at $120,383/-, as against 1,356 tons, valued at $219,110/- in 1927.

Chaulmoogra Oil.

A further experimental area was planted up at Serdang during the year with *Hydnocarpus anthelmintica* and *Taraktogenos Kurzii*. Additional supplies of *Hydnocarpus Wightiana* seed were received.

The results of an analysis made by the Chemical Division of the Department, of seeds of *Hydnocarpus anthelmintica* produced at Serdang showed that the proportion of kernel was approximately 30 per cent. The kernel contained roughly 52 per cent. of oil, which, calculated on the whole seed, is equivalent to 16.0 per cent.

A sample of *Hydnocarpus anthelmintica* nuts were submitted for trial at the Leper Asylum, Kuala Lumpur at the beginning of the year. As a result of these trials the Medical Officer in charge reported that no distinction could be drawn between them and the nuts which were obtained from Siam.

Further, he was of the opinion that the locally-grown nuts were of equal value to the Siamese ones and commented upon the good quality of the sample supplied by this Department.

Cover Crops.

Several new cover plants were introduced during the year, the most promising of which is *Tephrosia toxicaria*. This plant is very similar in habit to *T. candida* and its roots are stated to contain a toxic principle much the same as that found in certain species of *Derris* (tuba root).

A detailed report giving full information on the cultivation of some of the more important cover plants and green manures was published in the Malayan Agricultural Journal together with illustrations of the plants described.

Publications.

The following articles were published by members of the Staff of the Agricultural Division during the year 1928:—

"Observations on Oil Palms", by T. D. Marsh, Malayan Agricultural Journal, Vol. XVI, No. 1.

"An Ornamental Shade Tree"—*Muntingia Calabura*, by F. S. Banfield, Malayan Agricultural Journal, Vol. XVI, No. 1.

"Annual Report of the Agricultural Division", by B. Bunting, Malayan Agricultural Journal, Vol. XVI, No. 4.

"Preliminary Report on the Cultivation of Candle-Nut at Serdang", by T. D. Marsh, Malayan Agricultural Journal, Vol. XVI, No. 5.

"Notes on Dolichos Hosei, syn. Vigna Hosei", by B. Bunting, Malayan Agricultural, Journal, Vol. XVI, No. 5.

"Cover Crops and Green Manures", by B. Bunting and J. N. Milsum, Malayan Agricultural Journal, Vol. XVI, No. 7.

GENERAL.

Several papers were read by the Agriculturist at Planters' meetings during the year.

As usual the technical officers of the Agricultural Division made numerous visits to estates throughout the country with a view to giving advice on various agricultural problems requiring investigation.

B. BUNTING,

Agriculturist, S.S. & F.M.S.

Kuala Lumpur,

2nd April, 1929.

Division of Chemistry.

ANNUAL REPORT FOR 1928.

STAFF.

The staff of the Division on December 31st, 1928 consisted of the following officers:—

Agricultural Chemist.—B. J. Eaton, (Seconded for service with the Rubber Research Institute). C. D. V. Georgi (Acting.)

Assistant Agr. Chemists.—C. D. V. Georgi, V. R. Greenstreet.

Assistant Analyst.—Gunn Lay Teik.

Mr. R. O. Bishop, M.B.E. Acting Agricultural Chemist, proceeded on leave to Europe on May 4th previous to resigning from Government Service, the writer being appointed to fill the vacancy of the acting appointment.

The departure of Mr. Bishop in May has affected the work of the division considerably, since no officer has yet been appointed to fill the vacancy and there have been therefore only two European officers in the Division for seven months of the year. Certain investigations have had to be postponed until the appointment of a successor to Mr Bishop.

Coconuts.—The investigation regarding the alleged deterioration in value of Straits copra as compared with that from Ceylon and Malabar based on the oil content of the material, has been continued.

Several analyses of copra from different estates have been carried out, as a result of which it appears that the average oil content of estate copra, calculated on a moisture-free basis, varies from 64—67 per cent. The higher figure is less than that quoted for either the Ceylon or Malabar product, the oil content of which, calculated on a similar basis, varies from 68—72 per cent.

The statement that the oil content of Straits copra is less than the lower limit quoted above is probably accounted

for by the fact that a certain amount of estate copra is graded down to a selling standard with native copra, which is frequently prepared from immature nuts and therefore deficient in oil content.

The reason for the lower oil content of estate copra is at present uncertain, although it has been suggested that the deficiency may be due to the different climatic conditions prevailing in Malaya. In order however to ascertain definitely whether there is any seasonal variation in the oil content it is proposed to carry out systematic analyses of estate copra over a definite period.

The suggestion made in the last Annual Report regarding the valuation of copra on its oil content is not favoured by the European dealers, principally on account of the difficulty of securing representative samples.

A special feature of the work on coconuts has been the analysis of 290 samples of copra from special nuts supplied by the Economic Botanist in connection with selection experiments on this crop. The investigation is at present incomplete.

As a result of enquiries received from London regarding supplies of coconut charcoal a series of experiments has been carried out with the assistance of the Forest Chemist to determine the quantities of the various bye-products obtained by the dry distillation of coconut shell. The results have been summarised for publication in the Malayan Agricultural Journal.

Oil Palm.—The oil palm industry has developed considerably during the past year, 1460 tons of palm oil and 261 tons of kernels having been exported. These figures are greatly in excess of last year, when only 852 tons of oil and 178 tons of kernels were exported.

This comparatively rapid development has given rise to a number of problems connected with the factory process as regards increasing its efficiency and maintaining a high quality of product.

There is little doubt that as regards the treatment of the whole fruit the efficiency of the centrifugal process, that has been adopted in Malaya, compares favourably with that

of the press system, as employed in Sumatra. The centrifugal process results in the recovery of oil that contains only a relatively small amount of sludge and can therefore be purified with only a very small loss of oil. Experiments show that the loss of oil in the purification process should not exceed 0.1—0.2 per cent. of the oil recovered from the centrifugal extractor.

The question of the increase of acidity of palm oil on storage has been studied. It has been found that with oil of average quality the increase should not exceed 0.1 per cent. per month, the acidity being calculated as palmitic acid per cent.

In view of the probability of shipment of oil in tanks in the near future an investigation was carried out regarding the increase in the iron content of palm oil on storage in an iron drum. The results showed that there was no increase after three months.

The writer, who accompanied the agriculturist on a visit to Sumatra in connection with the Oil Palm Industry, wishes to record here his appreciation of the kindness shown to him during the visit, especially by members of the A.V.R.O.S.

A translation of the latest publication from Sumatra on oil palm, "The Manufacture of Palm Oil" by Ir. H. N. Blommendaal, was made for the Division by Mr. L. A. J. Rijk, Librarian and Translator. Copies of the translation were circulated to all oil palm estate managers and others interested in the crop, while a detailed abstract of the publication was also published in the Malayan Agricultural Journal.

Jelutong.—With the exception of Jelutong all investigations on forest products, hitherto undertaken in the Chemical Division, are now undertaken by the Forest Chemist (Dr. T. A. Buckley, M.Sc., A.I.C.). This officer works in the Chemical Laboratory, so that the Division is still in close touch with the chemical investigations of the Forest Department.

As regards jelutong particular attention has been paid to the question of development of brittleness in the material on storage, usually referred to as oxidation. Experiments have shown that traces of soluble iron added to the latex

before coagulation induce oxidation in the product, for example, the addition of soluble iron to the latex to the extent of 1 part of iron to 20,000 parts of latex will result in the crude coagulum becoming completely brittle after exposure to air for two months. The process of refining the material by boiling with water retards the development of oxidation to a certain extent.

Since iron can be introduced so easily into jelutong latex before coagulation, either owing to the use of a rusty tin for coagulation or as an impurity in the coagulant, the importance of ensuring cleanliness of coagulating vessels and the use of pure coagulants will be realised.

In view of the statement that jelutong from Kedah is particularly liable to oxidation two series of coagulation experiments have been carried out with latex from that source. The results shewed that there are no grounds for this statement, provided the coagulation conditions described above are observed. The experiments also shewed that the reason for Kedah jelutong having no marked tendency to develop mould on storage is due to the small proportion of serum solids present in the latex. These amount to only one-third of those present in local latex.

An investigation regarding the variations in the moisture contents of individual blocks of jelutong in consignments from various sources showed that the amount of variation between two blocks may be as high as 12 per cent. In view of this large variation and the fact that the material is sold on a standard moisture content of 45 per cent. the adoption of standard methods of sampling and determination of moisture was urged. These questions are now under consideration by the American dealers.

It is satisfactory to record a considerable increase in the local jelutong trade during the past year, 1002 tons being exported compared with 576 tons during 1927.

Tapioca.

The work on tapioca at the Government Experimental Plantation, Serdang has been continued. The second crop of tubers has been harvested and complete analyses made of representative plants from different plots.

As already outlined in the Annual Report for 1927 this work necessitated the consideration of problems connected with the sampling of a crop, also a method for a rapid and reliable estimation of small amounts of phosphate. The results of both these investigations have already been published in the Malayan Agricultural Journal.

Tapioca estates in Pahang, Johore and Kedah have been visited and analyses of various plant materials from those estates made in order to obtain comparative figures.

Experiments have also been carried out in factories both in Pahang and Johore as regards the determination of the efficiency of the method of manufacture at present in use.

The results of the various investigation are being summarised for publication in the Malayan Agricultural Journal.

A series of experiments has also been commenced at the Government Experimental Plantation, Serdang, to determine the change in the carbohydrate content of the tuber as it reaches maturity.

Alcohol.

The results of the investigation on the production of alcohol (Samsu) from rice were published in the Malayan Agricultural Journal, various suggestions being made as regards increasing the efficiency of the present process followed by the local Chinese producers.

Experiments with the residue from Pineapple canning factories have shewn that the production of potable alcoholic liquor from the liquid obtained by pressing this waste material is a simple process. Interest has been aroused and it is hoped that in the near future a process on these lines will be developed for the utilisation of the large amount of waste produce annually in these factories.

Piqui-a Fruit.

Further analyses of piqui-a fruits (*Caryocar villosum*) have been made. Piqui-a resembles oil palm in this respect that the fruit contains two oils, one present in the pericarp, the other in the kernel.

Experiments shewed that if good quality pericarp oil is to be recovered the material must be treated without delay on account of the development of acidity.

An interesting feature of the fruit is the relatively high tannin content of the rind.

Miscellaneous Crops from Government Experimental Plantation, Serdang.

The division has conducted chemical investigations during the past year on various crops being cultivated experimentally at the Government Experimental Plantation, Serdang. Among the investigations may be mentioned the following:—

(*a*) *Tuba.* Determinations of the ether extract of roots of *Derris elliptica* of various ages have shown that this variety of *Derris* should be harvested approximately 23 months after planting, the amount of ether extract reaching a maximum after this period. A similar investigation is being carried out with roots of *Derris malaccensis* (erect Sarawak).

(*b*) *Sisal.* The systematic investigation of the fibre content of sisal leaves from the experimental plots has been continued. The fibre content of the leaves now being harvested exceeds 5 per cent.

(*c*) *Gambier.* Periodical determinations of the gambier content of cuttings, based on the total quantity of matter soluble in hot water, have been made. The quantity of soluble matter amounts to approximately 8 per cent of the weight of the fresh cuttings. The investigation is nearing completion and the results are being summarised for publication in the Malayan Agricultural Journal.

(*d*) *Kapok.* The results of analysis of samples of kapok shew that the material compares favourably with the Java product.

(*e*) *Chinese Wood Oil.* An examination has been made of seeds of *Aleurites montana.* The physical and chemical characteristics of the oil have been determined and found to be in close agreement with the

accepted standards for Chinese Wood Oil. The latter oil is obtained from seeds of both *Aleurites Fordii* and *A. montana*.

(*f*) *Hydnocarpus*. An investigation is in progress regarding the oil content of the seeds of *Hydnocarpus anthelmintica*. The physical and chemical constants of the oil will also be determined.

Investigations for Economic Botanist.

The Division has also co-operated with the Economic Botanist in regard to routine analyses connected with the following special investigations:—

(*a*) *Rice*. Periodical determinations have been made of the moisture contents of rice stored under varying conditions. The results shew a definite increase in the moisture content of the material with the arrival of the wet season. The investigation is being continued.

(*b*) *Soya Beans*. Complete analyses of ten samples of soya beans have been made in connection with selection experiments on this crop. The oil contents of the beans varied from 17.5 to 20.4 per cent, calculated on a moisture-free basis.

Miscellaneous Analyses and Reports on Inventions.

The miscellaneous samples reported on during the year included 2 samples of copra, 8 samples of coconut cake, 9 samples of jelutong, 5 samples of concentrated rubber latex, 16 samples of fertilisers, 1 sample of lime and 1 sample of soda ash. 502 gallons of distilled water were supplied to the Posts and Telegraphs Department during the year.

Reports on 31 Patent Specifications were submitted to Government during the year.

Exhibitions.

A comprehensive exhibit of oil palm products and canned pineapples, including a small model of an oil palm estate, was despatched to the Canadian National Exhibition held at Toronto during August-September 1928.

An exhibit of oil palm products and tapioca was forwarded to the Malay States Information Agency for exhibiting at the British Industries Fair being held in London during February-March, 1929.

The writer acted as one of the judges in the Oils and Fats Section at the Malayan Exhibition held at Ipoh from August 3rd to 6th 1928.

Publications.

The following articles were published by the staff of the Division in the Malayan Agricultural Journal during the year.

1. "Bye-products of the Pineapple Canning Industry"—V.R. Greenstreet and Gunn Lay Teik, Volume XVI, No. 1.
2. "Samsu from Rice"—R.O. Bishop and Gunn Lay Teik, Volume XVI, No. 1.
3. "Studies on Tapioca. The Coeruleo-Molybdate Method for Determination of Phosphates"—V. R. Greenstreet, Volume XVI, No. 3.
4. "Studies on Tapioca. Sampling a Standing Crop"—V.R. Greenstreet, Volume XVI, No. 3.
5. "Division of Chemistry. Annual Report for 1927"—R.O. Bishop, Volume XVI, No. 4.
6. "Jelutong"—C.D.V. Georgi, Volume XVI, No. 5.
7. "Artificial Farmyard Manure"—V.R. Greenstreet, Volume XVI, No. 5.
8. "The Valuation of Jelutong"—C.D.V. Georgi, Volume XVI, No. 6.
9. "The Manufacture of Palm Oil". Abstract of Publication of Ir. H.R. Blommendaal—C.D.V. Georgi, Volume XVI, No. 6.
10. "Oil from Aleurites Montana"—C.D.V. Georgi and Gunn Lay Teik, Volume XVI, No. 8.

The Acting Agricultural Chemist collaborated with the Forest Economist (Mr. J. G. Watson) in the preparation of a short pamphlet entitled "Jelutong, its Tapping, Coagula-

tion and Refining''. The pamphlet was translated into Chinese and published in ''Ma Zoy Chow Nung Nyip Tsung Poh''—the Chinese Agricultural Journal.

Sd. C. D. V. Georgi,

Ag. Agricultural Chemist, F.M.S. & S.S.

5th January, 1929.

Division of Economics.

Annual Report for 1928.

Staff.—The Chinese Translator proceeded on leave in October, and was replaced by a Translator, lent by the Secretary for Chinese Affairs, for two days a week.

Major Crops.

Coconuts.—The Singapore market price for copra, which at the end of 1927 was $11.50 per picul (133⅓ lbs.), opened in January, 1928, at $11.90, around which price it stood until the end of the month. Thereafter, the price was maintained at between $11.35 and $11.50 until the end of May. The price subsequently shewed a downward tendency until the close of the year, when it was quoted at $10.05. The average price throughout the year was $10.92 as compared with $11.17, $11.80, $11.95, $12.12 in the respective years 1927, 1926, 1925 and 1924.

The satisfactory price of copra has enabled many estates to carry into effect drainage and other cultural operations during the last few years, the good effects of which are reflected in increased production. In view of the fact that about 80% of the coconut areas are held by small holders, the majority of whom have done little or nothing to improve their holdings, the increased production of the larger estates makes but little annual increase in the total copra production of the country.

Whereas the crops in 1927 were below average, those for 1928 were satisfactory in most districts.

The Economic Division commenced an investigation of costings in connection with coconut planting and cultivation, and the preparation of copra.

Arrangements were considered for the organisation of a Coconut Census in 1930.

TABLE I*a*.

Export of Copra from the Federated Malay States.

(Part of which was exported direct to foreign ports, and part to the Straits Settlements).

Year.	STATE.									
	Perak.		Selangor.		Negri Sembilan.		Pahang.		Total F.M.S.	
	Quantity Tons.	Value $	Quantity Tons.	Value $	Quantity Tons.	Value $	Quantity Tons.	Value $	Quantity Tons.	Value $
1924 -	38,554	6,914,055	12,903	2,427,188	1,179	203,930	561	95,839	53,197	9,641,012
1925 -	40,017	7,830,274	15,430	2,909,119	2,236	463,494	314	57,412	57,997	11,260,299
1926 -	44,542	8,905,033	16,963	3,212,553	3,417	575,451	907	158,733	65,829	12,851,770
1927 -	39,499	6,862,402	14,120	2,615,641	3,302	562,528	615	102,255	57,536	10,142,826
1928 -	45,451	7,535,319	20,148	3,435,968	2,251	381,675	654	106,746	68,504	11,459,708

TABLE Ib.

EXPORT OF COPRA FROM THE F.M.S. DURING 1928.

State	Exported to Straits Settlements.		Foreign Exports.	
	Quantity Tons	Value $	Quantity Tons	Value $
Perak -	34,474.67	5,720,130	10,976.34	1,815,189
Selangor -	10,665.06	1,775,325	9,482.52	1,660,643
Negri Sembilan -	2,244.57	380,660	7.04	1,015
Pahang -	633.40	103,360	20.50	3,386
Total -	48,017.70	7,979,475	20,486.40	3,480,233

TABLE II.

NET EXPORT OF COPRA FROM BRITISH MALAYA.

Year	Quantity (tons)	Value $.
1925	96,554	19,093,938
1926	104,653	21,852,330
1927	86,649	16,562,493
1928	95.091	18,747,129

Rice.—Statistics in connection with this crop will be found in the Annual Report of the Division of Economic Botany.

Miscellaneous Crops.—Apart from rubber, coconuts and padi, there are no crops grown in Malaya of any great importance, although four crops, viz:—pineapples, oil palms, coffee and tapioca, are of sufficient importance to be classified as "secondary."

The area under nipah, stated in table III, represents both plantation, for the production of power alcohol, and such areas of natural growth as are used for the making of roofing material.

Table III was compiled with the assistance of the Field Officers of this Department, the Land Officers and Managers of estates.

TABLE III.

Acreage of Miscellaneous Crops in Malaya, 1928.

State	Secondary Crops												
	Pineapples	Oil Palm	Tapioca	Coffee	Nipah	Areca nuts	Gambier	Bananas	Derris	Sago	Kapok	Tea	Spices
Selangor -	2,737	11,941	1,705	5,705	6,687	...	...	768	10	...	17	20	...
Perak -	457	5,240	512	404	4,290	374	...	1,157	387	...	76	...	...
Negri Sembilan -	105	600	836	585	445	7	329	2,316	269	...	...	8	1
Pahang -	3	482	616	718	...	100	1,856	...	...	...	308	25	...
Total F.M.S. -	3,302	18,263	3,669	7,412	11,422	481	2,185	4,241	666	...	401	53	1
Penang & Province Wellesley -	651	...	345	210	656	480	...	766	...	...	...	...	497
Malacca -	212	...	230	293	604	...	...	...	...	...	...	...	...
Singapore -	1,000	...	...	...	...	...	...	...	...	...	...	...	..
Total S.S. -	1,863	...	575	503	1,260	480	...	766	...	...	...	...	497
Johore -	35,000	6,477	14,000	2,500	...	8,500	1,600	...	2,000	600	...	...	...
Kedah -	...	...	5,000	500	...	...	...	1,000	...	...	...	500	...
Total U.M.S. -	35,000	6,477	19,000	3,000	...	8,500	1,600	1,000	2,000	600	...	500	...
Total Malaya -	40,165	24,740	23,244	10,915	12,682	9,461	3,785	6,007	2,666	600	401	558	498

Oil Palms.—Statistics relating to the present position of this industry will be found in Tables IV, V & VI. They shew that 4,985 acres were planted during the year 1928, making the total area under this crop in Malaya 24,740 acres. The planted area of the twenty-five estates with areas of land planted with oil palm is as follows:—over 2000 acres, six estates; between 1000-2000 acres, one estate; between 500-1000 acres nine estates; between 100-500 acres nine estates. It is estimated that the area to be planted in 1929 will amount to between 7,000 and 8,000 acres. Estates at present in existence with a portion of their land planted, have reserve land exceeding 25,000 acres representing alienations for the cultivation of this crop, but upon which planting has not yet commenced. It is estimated that the Government has earmarked a further 100,000 acres for alienation for this form of cultivation, but this figure must be accepted with caution, as in most cases it is not known what proportion of this area is suitable for oil palms, and certain areas are at present the subject of reconsideration in this respect. Six estates were producing oil during the year. The crops generally exceeded expectations; 1,460 tons of palm oil valued at $384,954, and 261 tons of kernels, valued at $43,475 were exported, representing an increase in weight of exports over 1927 of approximately 74% and 46% respectively.

A forecast of 1929 crops places production at 2,100 tons of oil and 430 tons of kernel.

Market prices for palm products have remained satisfactory throughout the year. The Malayan oil, on account of its purity, has commanded a premium over market quotations, and has mostly been put to specialised uses.

Palm kernels have obtained London market prices, which have varied from £20.15.0 to £20.3.0 per ton.

From the above figures it will be realised that the plantation palm oil industry in Malaya is gradually assuming a position of some importance.

TABLE IV.

Annual Exports of Palm Products from Malaya.

Year.	Palm Oil.		Palm Kernels.	
	Tons.	Value. $	Tons.	Value. $
1926	726	254,165	180	36,708
1927	852	269,966	178	31,763
1928	1,460	384,954	261	43,475

Prior to 1926, the export of palm products were not shewn separately in the returns published by the Registrar of Imports and Exports, who supplied the above figures. Estate production was, however, collected and is shewn under.

TABLE V.

Yield in tons of palm oil and kernel in Malaya.

Description of Product.	Year.			
	1923	1924	1925	1926
Palm Oil	195	286	536	751
Kernels	50	81	110	168

TABLE VI.

Annual Planting (in acres) of Oil Palms in Malaya.

State.	Year.													Total.
	1913	1914	1917	1918	1919	1920	1921	1922	1923	1924	1925	1926	1927	1928	
Selangor -	12	2	100	253	270	470	821	394	1,876	1,845	1,412	1,994	2,030	462	11,941
Perak -	...	...	...	...	...	...	...	...	...	220	...	478	1,818	2,724	5,240
Negri Sembilan	...	...	...	...	...	...	...	...	...	...	...	100	500	...	600
Pahang -	...	...	...	...	...	...	...	...	...	...	...	...	...	482	482
Johore -	...	...	...	...	...	...	...	...	30	10	962	1,289	2,869	1,317	6,477
Total Planted Annually -	12	2	100	253	270	470	821	394	1,906	2,075	2,374	3,861	7,217	4,985	24,740
Total Planted to Date.	12	14	114	367	637	1,107	1,928	2,322	4,228	6,303	8,677	12,538	19,755	24,740	

Pineapples.—The area under this crop and the export of canned pineapples have been well maintained during the year, while the prospect of future supplies appears favourable.

Complaints are received by the Department from time to time regarding the packing and quality of canned pineapples from this country. Until the exports conform more strictly to the demand in this respect, it cannot be maintained that the industry is in a satisfactory condition, or that the maximum advantage is taken of the position held by Malaya's trade over that of its competitors.

Advantage was taken to discuss the subject with packers and exporters in Singapore during the visit to Malaya in May of Mr. E. M. H. Lloyd of the Empire Marketing Board. Agreement of the parties interested was reached on one point, that of embossing each tin with the quality of contents; but it is doubtful whether, if accepted by the Home trade, this will go very far towards improving the quality and grading, although it will safeguard the product from unscrupulous retailers.

The market has been somewhat erratic during the past two years owing to lack of co-operation amongst packers and exporters. The combine of packers, established in 1926, appears to have been unable to stabilise quality or prices. The Economic Division is investigating these problems and comparing the situation with that obtaining in other countries, with the object of consolidating the position which the canned pineapples of this country hold on the United Kingdom market. In these efforts, the division has been in close touch with the Empire Marketing Board, and has also received willing assistance from the trade in Singapore.

TABLE VII.

Exports of Canned Pineapples from British Malaya.

Year.	Quantity.	Value (Straits $)
1919	255,973 cases.	3,286,001
1920	446,893 „	7,178,016
1921	662,630 „	6,210,383
1922	710,671 „	6,694,098
1923	889,941 „	5,874,858
1924	39,204 tons	8,873,977
1925	43,207 „	8,236,824
1926	40,634 „	7,669,784
1927	40,134 „	8,296,656
1928	46,400 „	8,421,230

Tapioca.—The cultivation of tapioca shews little advance; other crops, especially pineapples and coffee, receive more attention than tapioca as catch crops with rubber on newly opened land. The average price of "pearl" tapioca during the year was about $8.80 per picul, and of "flake" $8.50 per picul. The price for both grades shewed some decline during the year.

TABLE VIII.

The Tapioca Trade of Malaya.*

Year,	Imports.		Exports.	
	Tons.	Value. $	Tons.	Value. $
1925	6,010	762,582	37,000	4,818,528
1926	7,445	871,884	36,706	4,375,743
1927	8,085	905,672	25,139	4,243,992
1928	7,285	795,986	28,223	3,834,393

* Excluding the small trade in tapioca refuse.

Coffee.—An increased interest in coffee cultivation has been noticed during the past two years. Many enquiries regarding this crop have been received from planters and owners of small holdings. There is still scope for further planting for the local market, in addition to which the produce should find a ready market abroad.

TABLE IX.

Malayan Imports and Exports of Raw Coffee.

Year.	Imports.		Exports.	
	Quantity lbs.	Value. $	Quantity lbs.	Value. $
1925	18,878,848	6,469,775	11,788,036	4,113,318
1926	18,515,244	6,084,110	9,931,876	3,319,597
1927	18,612,643	5,144,631	10,074,931	2,771,496
1928	14,073,996	4,136,554	6,781,929	2,029,425

Areca nuts.—Care in curing materially affects prices, and the local industry continues to suffer by reason of insufficient grading and carelessness in curing. Good sundried nuts always command a satisfactory price, though other grades also find their specialised market if of sufficiently high standard to compete with the products of other countries.

Production has been maintained, although the Johore main crop was reported to have fallen off.

Prices shew a decline over those of the previous year The average declared trade value per ton, of Exports in 1927 was approximately $206 per ton, while in 1928 it fell to $178 per ton. The average Singapore prices per picul of the various grades of areca nuts were as follows :—

Split $9.50; Kelantan Split, $8.30; Whole, $5.00; Palembang, $7.52; Red Smoked, $11.38; Sliced $16.15.

TABLE X.

Malayan Imports and Exports of Areca Nuts.

Year.	Imports.		Exports.	
	Quantity Tons.	Value $	Quantity Tons.	Value $
1925	39,952	10,007,864	58,902	18,293,061
1926	40,497	9,396,674	63,012	17,286,800
1927	32,110	5,876,087	49,873	10,298,771
1928	45,185	6,980,937	69,303	12,196,258

Derris (Tuba root).—The area under this crop is very small, owing to the difficulty in establishing a satisfactory market. The use of this root as an insecticide is being investigated in several countries, for which purpose the Division has forwarded bulk samples.

Kapok.—No further advance has been made in the cultivation of kapok, the industry still being confined to scattered areas in native holdings.

An attempt has been made to arrange for the marketing of kapok seed from holdings along the Perak river. The amount of such seed is inconsiderable, and is at present discarded. Its sale, however, might prove an incentive to planting, and would be a welcome addition to the income of the Malays in the district. An exporting firm was placed in touch with this source of seed, and the organisation of collecting seed and forwarding to Teluk Anson is now available.

Rubber Seed.—The import of rubber seed into Malaya during 1928 amounted to 5 tons, valued at $28,590 The value per ton, viz $5,719, indicates that this seed was all destined for planting purposes. The export of rubber seed over the period was 7,905 tons, valued at $246,940, i.e. $31 per ton, practically all of which was intended for the extraction of oil. The establishment of a market for this bye-product of the rubber industry is due to an American Company which has organised the purchase of seed from estates.

The Division instituted an investigation of the marketing of rubber seed. It was estimated that the total seed crop of Malaya probably amounts to 200,000 tons, half of which might be economically marketed. The 1928 season was not considered one of abundant rubber seed yield. The collection was treated as a spare time occupation, and, especially on estates with Indian labour, one of considerable value to the labour force. The average cost of collection and packing amounted to $11.00 per ton. The purchasers offered $22/- per ton on rail, so that, provided the estate was not too distant from rail, or port, a profit of from 50 per cent. was obtained.

Supervision in collecting and packing the seed was in some cases insufficient, resulting in an accumulation at Malayan ports of stock which was unable to obtain a certificate of freedom from pests and diseases, which is required before entry into the importing country. Planters have gained valuable experience during the past season in the marketing of rubber seed, and it is anticipated that improved returns will result from a closer supervision of the collections.

Live Stock.

The Governments of the Federated Malay States have rendered annual returns of live stock for 1928 (see table XI) The stock in Negri Sembilan, and of cattle in Selangor, has been well maintained, but the number of cattle in Perak, and of all live stock in Pahang, shew a further serious decline of approximately 25% over the previous year. The effect of this diminution of stock in Pahang, caused chiefly by disease, floods, and unsuitable feeding, has proceeded unchecked since 1923, and is reflected in the reduced padi production returns of the State.

The Division placed these figures before the Agricultural Advisory Committee, whose suggestions have been referred to the States concerned.

It is understood that the Pahang Government has imported stock to replace, in part, that lost in the 1926 flood, and is fully alive to the seriousness of the present position. In view of the desirability of increasing food production, and of the relationship of live stock to the amount of food crops produced, an increase in stock, especially buffaloes for working the padi lands, must be considered of great importance

Table XI.

Live Stock in the Federated Malay States, 1928.

State	Bullocks			Buffaloes.			Goats and Sheep		
	Male	Female	Total	Male	Female	Total	Male	Female	Total
Perak -	5,713	7,349	13,062	6,309	8,913	15,222	7,759	17,622	25,381
Selangor -	-	-	9,024	-	-	1,617	No returns.		
Negri Sembilan -	3,403	4,054	7,457	2,937	6,198	9,135	6,027	13,038	19,065
Pahang -	-	-	2,993	-	-	10,098	-	-	4,372
		Total	32,536		Total	36,072		Total	48,818

The census of poultry in Malaya has never been attempted, but the import of poultry and eggs points to the fact that there is room for an extension of poultry keeping in Malaya. A disease of poultry, the symtoms of which closely resemble Roup, has been reported to the Division from several districts, in particular from the Coast districts of Selangor, Negri Sembilan and Malacca. With the advice of a poultry expert, a special leaflet on Roup was published in the Malay language. It is to be feared, however, that the recognised remedies for this disease have not been particularly effective in the present case, and the loss of poultry has been considerable.

Publications.

Two illustrated booklets, viz: "The Oil Palm in Malaya", and "Malayan Pineapples", were prepared for the National Exhibition at Toronto, and were also later distributed at certain exhibitions in England.

"Malaya: Agriculture", an illustrated booklet, was compiled at the request of the Malay States Information Agency, and forwarded to London for publication.

"Annual Report of Division of Economics, 1927," Malayan Agricultural Journal, Vol. XVI, No. 4.

"The Agricultural Trade of Malaya for the first half year 1928", and "Copra and Coconuts" (a book review), Malayan Agricultural Journal Vol. XVI, No. 8

"London Market Price List 1928", Malayan Agricultural Journal, Vol. XV, No. 12.

"Notes on Oil Palm and Miscellaneous Crops", for the Planters Association of Malaya, Year Book 1927—1928.

Vernacular Publications.

Warta Perusaha-an Tanah, the Malay Journal of the Department, Volume VI, was published in four quarterly parts with thirteen illustrations. Owing to the demand, the distribution increased from 3,500 copies per issue at the end of 1927, to 5,000 copies during the second half of 1928. In all, 17,000 copies were distributed, against 12,000 for the previous year.

Special Malay Leaflet No. 6 : "Roup—a disease of Poultry" : 5,000 copies were printed for free distribution.

Chinese Agricultural Journal, Volume II, was published in four quarterly parts of 5,000 copies each, with a total of twenty-one illustrations.

The Co-operative Societies Department and the Rubber Research Institute of Malaya have co-operated in the use of the vernacular publications of this Department for their propaganda work amongst Asiatics.

The Sarawak Government has placed an order for 500 copies of all future issues of both the Malay and Chinese publications.

Vernacular publications are distributed free in the Federated Malay States and Straits Settlements. Expenditure for the year decreased by $1,720 to $4,023, while revenue from sales and advertisements increased by $795 to $2,363.

The printing of the Malay Journal was undertaken by the Government Printing Department, Singapore, from the beginning of the year. This resulted in an improvement in production and distribution.

Acknowledgments are again due to numerous contributors to both journals, as well as the writers and publishers of many articles which have been altered and adapted for presentation to Asiatic small holders.

The steadily increasing amount of correspondence from Asiatic readers of these journals is evidence of the utility of these publications.

Agricultural Exhibitions & Shows.

The following Exhibitions and Shows have been held during the year :—

Malacca,	July 21, 22.
Sixth Malayan Exhibition, Ipoh,	August 3—6.
Perak North, Taiping,	August 19, 20.
Lower Perak, Teluk Anson,	September 9.

All the above shows were held under the auspices of the Malayan Agri-Horticultural Association, of which the writer is Joint Hon: Organising Secretary. The Agricultural Economist officiated as a judge at two of the above district shows.

The Malayan Agri-Horticultural Association continued the publication of a quarterly magazine. Work has progressed in the laying out of a permanent site in Kuala Lumpur for the Annual Exhibition of the Association.

General.

The Agricultural Economist acted as Asst: to the Secretary for Agriculture in addition to the duties of his substantive appointment. He also served on the Advisory Committee for the School of Agriculture, Malaya; as Secretary of the Agricultural Advisory Committee, and (from June) as a member of the Co-operative Board.

D. H. Grist,

Agricultural Economist, F.M.S. & S.S.

7th March, 1929.

Tables Ia, Ib, II, V, VII, VIII, IX, X, are abstracted or compiled from official returns of the Customs Department.

Division of Economic Botany.

Annual Report for 1928.

Staff.

The writer was in charge throughout the year and the Staff of the Division was as follows:—

Dr. H. W. Jack, Economic Botanist (in charge).

Mr. W. N. Sands, F.L.S. Assistant Economic Botanist at Kuala Lumpur.

Mr. R. B. Jagoe, B.Sc. Assistant Economic Botanist at Kuala Lumpur.

Inche Mohamed Noor, Senior Agricultural Assistant at Parit Buntar.

Inche Tajudin, Junior Agricultural Assistant at Kuala Lumpur.

Inche Abdul Rauf, Field Assistant at Parit Buntar.

Inche Abdul Rahman, Field Assistant at Klang.

Mat bin Mat Saman, Mandor at Titi Serong.

Inche Abdul Jabbar, Clerk at Kuala Lumpur.

I have to thank all the above for loyal co-operation and for their good work throughout the year.

Mr. W. N. Sands was away in Europe on furlough for $7\frac{1}{2}$ months during the year, and Mr. Jagoe was away on military duty in Hongkong for 3 weeks.

Coconuts.

Individual yield records from 530 palms, growing under average estate conditions, have been maintained for eight years in succession, and the data thus collected have afforded instructive information concerning the variation in yield of individual palms in commercial plantations.

The data show that (1) over a period of eight years the coefficient of variability of an average population is as much

as 34% of the mean production per palm; (2) that variability in cropping per palm per annum ranges from 5 to 115 nuts on the block from which the data were collected; (3) that 19% of the palms of an average plantation are not profitable under normal treatment; (4) that 15% of the palms produces 24% of the total crop, and (5) that poor yielders remain poor yielders while good yielders are constant to that character.

In view of these results, the desirability of selecting seed nuts from known high producing palms is very evident.

Moreover, data have been compiled which show that the copra content of nuts from different palms (of the same variety) varies from 79% to 131% of the mean copra production per nut. Further data regarding variation in oil content of copra from different palms, and seasonal variation in oil content of copra from the same palms, are in process of compilation.

The coconut selection experimental area at Klang has been maintained in good condition and the general growth of the palms is satisfactory.

Beetle attacks are a constant source of trouble, an average of one beetle to every 18 palms being found each month throughout the year.

The area was visited by the Mycologist and Entomologist in connection with disease and pests and three palms have been cut out suffering from "bud-rot" while "kerengas" and scale insects have been a nuisance on several palms.

The manurial, cultivation, and catch crop experiments are also being maintained on this area. "Trenching" and row-mounding already appear to be effective methods of cultivation with heavy soils, for their effects on the young palms are very marked in greener foliage, more leaves and leaflets, and thicker crowns compared with adjacent "uncultivated" palms of the same age.

Manurial experiments on mature coconuts have been put into operation on Carey Island, on a block of 18 year old palms of which the yields of each palm are known for the last eight years. This block should afford much useful in-

formation, regarding efficient manuring for coconuts, in the next two years or so.

Data have been compiled from 30 representative estates in Malaya which show that there is a seasonal variation in output of copra per acre of 15% of the average crop. These data also show that the average production of copra per acre per annum, from European managed estates, is 8.734 pikuls (1,162 lbs.), and that 251 nuts are required to produce 1 pikul (133 lbs.) of copra. They also afford interesting figures of the average costs of various operations on coconut estates (See Malayan Agricultural Journal, Vol. 16, Nos. 8 & 11, 1928).

Records of the flowering and fruiting characters of races of dwarf palms, growing in the Parit Buntar office compound, were maintained for the 4th year in succession, and results will be published at an early date.

There has been little extension in the area planted with coconuts during the year though a slight increase (perhaps 3%) on the 1924 figures is probable.

An exhibit was staged at the Ipoh and Taiping Agricultural Shows, to show the variation in yield of nuts and copra per palm on average plantations.

Oil Palms.

Variation studies of individual palm fruits were maintained and preliminary arrangements have been made for compiling a palm crop register on a population of palms growing under good average estate conditions.

Arecanuts.

Excellent growth has been shown by the twenty varieties of arecanut palms growing at Klang though fire damaged one variety somewhat.

Soya Bean.

Selection experiments with this useful bean continue and promise interesting results. The number of selections was reduced during the year from 31 to 19 strains. The best

strains are those of the varieties Nos. 3 and 4, the former being a selection from a variety originally obtained from Siam, and the latter a selection from a local variety originally imported by Chinese agriculturists and grown for some years in Pahang (Manchis). Several strains of each of these varieties are promising and are being multiplied at the Serdang Experimental Plantation.

Cotton.

A collection of fifteen selections from Sea Island, Egyptian and Upland varieties were grown in small plots and, as usual, a fair crop was obtained. The cottons have been maintained in pure lines for the past seven seasons without any apparent deterioration in yield or quality of the lint.

The original selections have now been reduced to six, namely 2 Sea Island, 3 Egyptian and 1 Upland.

Lint valuations received from Shanghai mills (which favour Nos. 1, 2, 16 and 24) gave the following prices in August last:

E.B. No.	1. Egyptian	...	10	pence per lb.
,, ,,	2. ,,	...	15	,, ,,
,, ,,	16. ,,	...	14¾	,, ,,
,, ,,	6. Sea Island	...	18½	,, ,,
,, ,,	5. ,,	...	17¼	,, ,,
,, ,,	24. Upland	...	10	,, ,,

It may be mentioned that No. 6 is the most prolific producer under local conditions.

Whilst it is unlikely that cotton will prove a remunerative crop along the West Coast of the Peninsula, yet it should be possible to grow selected varieties successfully in Kedah, Perlis, Kelantan and Trengganu, if expert advice and assistance concerning planting, cultivation, ginning, baling and control of pests and diseases was available to growers.

Maize.

As anticipated, considerable difficulty was experienced in maintaining the selected strains of local yellow flint maize

which had been inbred for five generations. Numerous crosses were made between them during the year, and further crosses will be made with the object of obtaining strong growing and heavy yielding types of the local varieties.

Padi.

The padi crops in the F.M.S. were slightly under the average of the past 14 years, partly because of late planting so that the standing crops were badly damaged by the March—April rains, but partly because of a drought, early in the growing season, followed by deep water at planting time. In the Straits Settlements the crops were good being well above the average.

In the Unfederated States an early drought affected the padi adversely so that the crop harvested were somewhat below the average over the last decade.

The summary of padi returns is shown as Appendix I.

Pure line selection work was maintained at Titi Serong along the lines already laid down and though good crops were grown, the lateness of the season resulted in much damage, and loss of grain during harvest, by continuous rains, so that the Krian crop was some 14% below average. Rat damage in Krian was distinctly less than usual during the past year—thanks to the energetic destrucion campaign carried on by the Field Division. Titi Serong pure lines continued to give satisfactory results throughout Perak North.

The Agricultural Field Officer, Perak North, reported increased yields in the Kuala Kangsar District varying from 21% to 72%, and in Larut District the increases range from 9% to 35%. In Pahang very heavy crops from selected seed were grown at Pekan on the flood silt of the previous year, yields up to 800 gantangs per acre having been recorded by the Agricultural Field Officer.

In Perlis the Adviser reported increases in yield from the pure lines Radin Nos. 2 and 13 of up to 50%, and stated that these strains were popular because of the ease of threshing them and their flavour.

In the Pasir Puteh District of Kelantan, the District Officer reported that Krian selected seed produced crops vary-

ing from 25% to 33% better than crops grown from local seed, and that "the rayats were most enthusiastic" to get further supplies of seed which have been sent. Seed has also been sent to Trengganu for trial and results should soon become available. Promising results are reported from Kedah and good results were also obtained in other areas. A particularly successful demonstration plot was planned and supervised by the District Officer, Jelebu, and yields of between 500 and 600 gantangs were obtained from selected seed as against local crops of around 400 gantangs,—more of these demonstrations are very desirable. The gradual increase in the number of padi inspectors should help towards gaining reliable reports of the use of selected seed, and towards breaking down the conservatism which still exists towards the introduction of new and tested seed.

The customary use of the "tuai" in some places has deterred cultivators from using selected seed, because the crops ripen simultaneously and with one strain Radin No. 7, though good crops are admitted; the straw is rather tough for harvesting with the "tuai". Selected seeds have, almost everywhere, given crops which show comparative resistance to lodging under adverse weather conditions nearing harvest, give better milling returns, and shed less grain than crops grown from unselected seed. Approximately 14,900 gantangs of selected seed were distributed or sold during the year.

Hybridization methods are now also in progress with a view to improving still further the best selected strains. A number of hybrid seeds between the best 3 or 4 strains were successfully ripened after last harvest, but, as the seedlings were growing in the present season, all were unfortunately destroyed by rats, thereby involving the loss of a year with this branch of work.

Manurial experiments continue in Province Wellesley, Krian, Malacca and Kuala Kangsar, and, though definite results are necessarily slow in materialising, fairly definite indications as to the best manures for improving grain yields may be said to be in sight. Wide variation in soil texture and in water facilities render manurial work rather complicated, and the vagaries of our seasons do not assist in the solution of the problem.

Cultural experiments continue in the same centres as the manurial experiments, but the effects of different forms of cultivation are so frequently masked by seasonal conditions that progress is slow. The disadvantages of planting too many seedlings per hill and of too close spacing has been proved; also the efficacy of clean weeding and intensive tillage as compared with haphazard methods and the importance of water control is, of course, well known. Beneficial effects are indicated when land is ploughed immediately after harvest on certain soils, but soils differ so much that it is difficult, as yet, to make specific recommendations.

Catch crops do not yet stand much chance of success since the average cultivator will not yet consider the prospect of tilling his land more than once a year, though possibly cultivators in the Unfederated States may prove more energetic in this direction. There is some chance for the cultivation of early maturing crops on the "batas" in certain areas where they are rich in organic matter, e.g. soya bean and maize in Krian, and this aid towards increasing food crops is being kept in view. Rice storage experiments are proceeding satisfactorily.

The adoption of small power rice mills, as advocated by this Division since 1922 towards maintaining the price of padi, is slowly gaining favour on estates situated within easy distance of regular padi markets, thus encouraging padi production.

Botanical.

The Herbarium of local economic plants was maintained in good condition and numerous plant identifications were made for various applicants.

A study was made by the Assistant Botanist of the bitter Cucumber or Peria (Momordica Charantia) and its varieties. The Peria is highly esteemed locally by Malays, Chinese and Indians as a vegetable. An article containing a full description of the vegetative, flowering and fruiting, characters of the plant, together with information concerning the uses to which it is put was published in the Malayan Agricultural Journal (Vol. XII. No. 2. 1928).

The senior Assistant Botanist, in collaboration with the Secretary for Agriculture, undertook an investigation con-

cerning the plants growing on disused mining areas. As a result the use of certain plants was recommended for trial in the reclamation of lands covered with sand and silt.

General.

The Economic Botanist visited Kedah, Kelantan and Trengganu early in the year and submitted reports on padi crops in Kedah and Trengganu, together with recommendations for the improvement of rice industry in those States. The Right Hon. Mr. Ormsby-Gore visited the Rice Experiment Station at Titi Serong and the Selection Experiment Station at Klang during the year. The Economic Botanist prepared two papers for the Pacific Science Congress in Java 1929 one on the "Rice Situation In Malaya" and one on "Selection in Coconuts".

H. W. Jack,

Economic Botanist, S.S. & F.M.S.

Kuala Lumpur,
10th January, 1929.

Summary of Padi Returns—British Malaya.

State.	WET		DRY	
	Acreage	Yield	Average	Yield
	Federated Malay States.			
Perak ...	87,626	19,557,455	6,535	844,443
Selangor ...	13,060	1,669,077	3,579	558,449
N. Sembilan ...	31,555	3,875,692	(included in wet)	
Pahang ...	21,995	3,733,004	7,803	805,436
Total, F.M.S. ...	154,236	28,835,228	17,917	2,208,328
Krian ...	55.182	12,423,774	—	—
	Straits Settlements.			
Singapore ...	—	—	—	—
Penang ...	5,060	2,170,700	—	—
Malacca ...	27,669	8,913,849	—	—
P. Wellesley	39,505	10,942,000	—	—
Dindings ...	600	180,000	470	127,500
Total, S.S. ...	72,834	22,206,549	470	127,500
	Unfederated Malay States.			
Johore ...	3,275	390,181	3,774	854,513
Kedah ...	170,999	53,020,957	1,548	215,205
Perlis ...	32,645	5,434,400	—	—
Kelantan ...	175,312	18,826,980	60	7,200
Trengganu* ...	22,000	2,200,000	8,000	800,000
Total, U.M.S. ...	404,231	79,872,518	13,382	1,876,918
Total, F.M.S. ...	154,236	28,835,228	17,917	2,208,328
,, S.S. ...	72,834	22,206,549	470	127,500
,, U.M.S. ...	404,231	79,872,518	13,382	1,876,918
,, Malaya ...	631,301	130,914,295	31,769	4,212,746

*Estimated by inspection.

Division of Entomology.

ANNUAL REPORT FOR 1928.

Staff.

Mr. H. T. Pagden and Mr. N. C. E. Miller, Assistant Entomologists, reported for duty on the 4th January and the 5th May, 1928, respectively.

PUBLICATIONS.

The following papers were published:—

"Some General Remarks on the Influence of Climatic Conditions on the Prevalence of Economic Insects in Malaya", M.A.J., Vol. XVI, No. 1, January, 1928.

"*Leptoglossus membranaceus* F., a Pest of Cucurbitaceae", M.A.J., Vol. XVI, No. 12, December 1928.

"A list of Parasites and Predators with their Hosts in Malaya", M.A.J., Vol. XVI, No. 12, December, 1928.

A REVIEW OF THE INSECTS OF 1928.

1. INSECTS OF CROPS.

COCONUTS.

(a) Insects of the Inflorescence.

Tirathaba rufivena Wlk. (The Greater Coconut Spike Moth).

Batrachedra arenosella Wlk. (The Lesser Coconut Spike Moth).

Chelisoches nigronitens St.

Earwigs are always active on the inflorescence and probably feed for the most part on decaying male flowers but no direct damage has been observed.

Diocalandra frumenti F.

This weevil is somewhat similar in its habits to *Chelisoches nigronitens* St.

Derelemorphus eburneus Mshll.

This is another very small weevil which has recently been described by Marshall.

Platydema nuciferae Blair, *Carpophilus fovicollis* Murr. and *Carpophilus dimidiatus* F.

The Tenebrionid, *Platydema nuciferae*, has recently been described by Blair.

Xylotrupes gideon L.

This large familiar beetle, which generally confines its attention to feeding on the undersurface of the petioles causing "leaf-break", has been observed on several occasions feeding on the branches of the inflorescence.

Anathesis laconoides Cand.

Occasional specimens of this click-beetle have been collected from the inflorescence.

Pyroderces ptilodelta Meyr., *Erechthias pavistriata* Wals *Opogona dimidiatella* Zell. and *Stathmopoda adulatrix* Meyr.

Pyroderces ptilodelta is by far the most common.

Haplothrips ceylonicus Schmutz.

This thrips is ever present on the inflorescence and is frequently found inside the opened male flowers probably feeding on pollen.

Mites.

Inflorescences are always covered with mites in exceptionally large numbers.

Oecophylla smaragdina F.

This "keringa" or red ant is the most numerous insect on coconut-palms, frequently webbing the pinnae together.

(b) *Insects of the Leaf and Stem.*

The most important pest of the leaf this year has been the Limacodid moth—*Setora nitens* Wlk. and several reports of damage have been received. Most complaints have been received from the Teluk Anson district and after visiting that area recommendations for its control were made.

Hidari irava Moore.

Occasional reports of injury by the caterpillars of this Hesperiid butterfly have been received but the damage has been confined to small areas. This insect is undoubtedly generally controlled by parasites.

Artona catoxantha Hmps.

The only outbreak of this moth was reported in October from Singapore but rains at the commencement of November were responsible for its termination.

(c) *Miscellaneous Insects.*

The Psychid caterpillar—*Mahasena corbetti* Tams.—caused some damage to young palms and *Amathusia phidippus* L. was recorded for the first time severely injuring one area.

Occasional caterpillars of *Melanitis hypermnestra* L. and *Altha albiguttatus* Snell. were collected.

The Ortalid, *Trigonosoma perilampiforme* Gray., was obtained from a decaying bud and the Dynastid, *Chalcosoma atlas* L., was reported boring the crowns of a coconut palm. The Lyonetiid, *Decadarchis heterogramma* Meyr. was obtained from decaying leaflets of the coconut.

Elaeis Guineensis.

Setora nitens Wlk. was troublesome on one Estate and *Oryctes rhinoceros* L. was responsible for boring the base of petioles.

Leguminous Cover Crops and Green Manures.

Cover crops are liable to the attacks of numerous insects. The most common is the caterpillar of *Lamprosema diemenalis* Guen., *Centrosema Plumieri*, *Clitoria cajanifolia*, *Pueraria phaseoloides*, *Calopogonium mucunoides*, *Desmodium gyroides*, *Dolichos biflorus*, *Tephrosia candida* and *Glycine hispida* have all been observed during the year suffering from the attacks of this insect. Another common caterpillar is the larva of the Lycaenid, *Zizera otis* Fabr. The Pyralid, *Syngamia vibrusalis* Wlk., has occasioned slight damage and the Gracilariid, *Acrocercops caerulea* Meyr. has been recorded mining the leaves of *Vigna catjang*. The following bugs

have been recorded during the year from various covers, *Coptosoma impicticollis* Mont., *Chauliops bisontula* Banks., *Halticus minutus* Reut., *Cyclopelta obscura* Lep., *Physomerus grossipes* F. and *Anoplocnemis phasiana* F.

The beetles, *Pagria aeneicollis* Lef. and *Oncorane modesta* Jac. have also been recorded.

Lampides (Lycaena) boeticus L.

This Lycaenid feeds on the flowers of Leguminosae, *Vigna catjang* in particular. The damage caused by this insect is the complete destruction of the flowers.

Etiella zinckenella Treit.

This Pyralid is another pest of Leguminous seeds.

Etiella has been bred from the seeds of *Tephrosia candida*, *T. toxicaria* *T. purpurea*, *Crotalaria incana*, *C. striata*, *C. usaramoensis* and *Cajanus indicus*.

An examination of 403 pods of *Tephrosia toxicaria* gave a percentage infestation of 7%.

Parasites. A Braconid parasite—*Chelonus* sp.—has been bred from the larva.

Maruca testulalis Hb.

This Pyralid attacks numerous leguminous plants and may feed either in the seed-pod or on the leaves. It is recorded from seed, flowers and leaves. *Vigna catjang* (seed), *Derris* spp. (flowers and leaves), *Mucuna pruriens* (pods), *Phascolus multiflorus* (pods) and *Sesbania aculeata* (leaves). *Deiopeia (Utetheisa) pulchella* F.

This Arctiid attacks various species of *Crotalaria* and has been bred from both seed-pods and leaves of *Crotalaria usaramoensis* and *C. incana*.

Brachyacma palpigera Wals.

A Gelechiid feeding on seeds of *Tephrosia candida*, *T. hookeriana* and coffee berries.

Araecerus fasciculatus de Geer.

An Anthribid attacking the seeds of leguminous and numerous other plants, both in the field and store. It has been bred from rubber-seed cake, dried areca-nut and Brazil nut, from the seed-pods of *Tephrosia candida*, *T. hookeriana* var. amoena, *T. toxicaria* and *Clitoria striata*, seeds of *Phaseolus vulgaris* and coffee and from the decaying stem of *Carica papaya*.

In the case of *Tephrosia toxicaria* out of 403 pods examined over 25% were attacked by larvae of *Araecerus*, in some cases there were as many as four larvae in a pod.

Coffee.

Extensive defoliation of coffee bushes occurred in Johore by the caterpillars of the hawk moth, *Cephonodes hylas* Linn. An Encyrtid egg-parasite has been recently discovered and possibly is the agent responsible for the termination of outbreaks.

The coffee berry beetle, "boeboek", *Stephanoderes hampei* Ferr. was responsible for boring 90% of the berries on an Estate in Selangor.

Both the beetle, *Araecerus fasciculatus* de Geer, and the Gelechiid moth, *Brachyacma palpigera* Wals., have been bred from berries collected in the field.

The scale-insect, *Coccus viridis* Green., and the Limacodid *Belippa laleana* Mr., have been reported on a few occasions causing damage to the leaves.

Padi.

Leptocorisa acuta Thnbg. caused no extensive damage in the Kuala Pilah area. It was reported in some numbers at Repah, Negri Sembilan, at Kutob, Johore, and a few other places.

Leptocorisa acuta, if conditions are dry, appears to lead a solitary life, but grasses, bursting into flower just before the padi, attract these solitary individuals and if these places are immediately dealt with there is little danger of extensive damage to padi occurring.

Scotinophara coarctata F. occurred in some numbers at Lenggong in Upper Perak and at Blanja, Parit. An outbreak at Kuang was controlled by flooding the fields after heavy rains.

The Jassids, *Nephotettix bipunctatus* F. and *Sogata pallescens* Dist., were received from the Krian district and were reported to cause slight injury. Other insects damaging padi are *Diatraea auricilia* Dudg. and a *Diatraea* sp., *Schoenobius bipunctifer* Wlk., *Sesamia inferens* Wlk. and *Anadastus filiformis* F. The last is an Erotylid beetle. Its larvae feed inside the top internode of the stem. The beetle is generally found on the inflorescence and probably feeds on the pollen.

A nematode worm has been obtained from the moth, *Schoenobius bipunctifer* Walk.

The leaf caterpillars, *Nymphula depunctalis* Guen., *Melanitis ismene* Cram., *Spodoptera mauritia* Boisd., *Cnaphalocrocis medinalis* Guen., *Cnaphalocrocis* sp., *Parnara bada* and *P. mathias* F. and *Telicota bambusae* Moore. have all caused some damage to padi. The caterpillars of *Parnara bada* were found parasitised to the extent of 80% by a Braconid. A Chalcid was bred from *C. medinalis* and an unidentified *Odynerus* sp. was taken preying on the larvae of *Cnaphalocrocis* sp.

An investigation of padi "bugs" other than *Leptocorisa acuta* Thnbg. and *Scotinophara coarctata* F. has been commenced. They are the Coreids, *Riptortus linearis* F., and *Cletus punctiger* Dall. and the Pentatomids, *Menida varipennis* Westw., *Menida histrio* F., *Tetroda histeroides* F., *Nezara viridula* L., *Eusarcoris ventralis* Westw., and *Zicrona coerulea* L.

Croton tiglium.

The Noctuid moth, *Amyna punctum* F. is the principal pest of *Croton.*

An outbreak of *Amyna* may usually be expected in late December or early January and will rapidly increase in severity until the trees are defoliated if no steps are taken. With the first heavy rains, the insect almost completely disappears.

No parasites have been recorded.

Nipah (*Nipa Fruticans*).

Parasa lepida Cram. has again been prevalent and undoubtedly is the most important enemy to nipah. Hand collecting instead of spraying has been adopted on one Estate. The three Hispid beetles—*Wallacea palmarum* Gestro., *Plesispa reichei* Chap. and *Plesispa nipa* Maulik, have been recorded causing slight damage. *Pyroderces haemodryas* Meyr., has been obtained from the nipah inflorescence and a Pyralid caterpillar has recently been found damaging seedling shoots.

Roselle.

Dysdercus cingulatus F. caused great damage to Roselle at Serdang.

Areca catechu (Areca Nut).

Mahasena corbetti Tams. was occasionally abundant, whilst *Wallacea palmarum* Gestro., by feeding at the base of the young leaves, was responsible for killing occasional plants.

The most important enemy to this crop, however, is an unidentified Capsid bug which sucks the very young flowers causing the eventual discolouration of the fruit.

Quinine.

The most important insect was *Helopeltis cinchonae* Mann. which was responsible for not only dwarfing the growth of quinine in the field but especially damaging seedlings in the nursery.

The hawk moth, *Deilephila hypothous* Cram. was instrumental in causing slight damage to *Cinchona ledgeriana* in the Gardens, Kuala Lumpur.

Cinnamon.

The Cerambycid, *Thermonotus oberthuri* Ritz., the grubs of which bore the trunks of Cinnamon, killed a large percentage of trees on one Estate. Little attention was be-

ing paid to sanitation. The leaf tier, *Cricula trifenestrata* Helf. was also prevalent.

The caterpillars of *Attacus atlas* L., *Lecicoma submarginata* Wlk., *Orgyia mendosa* Hb., *Papilio sarpedon* L., *Pingasa ruginaria* Guen., *Therctra nessus* Dru., and *Aritta rufifrons* Moore, have all caused slight damage.

Camphor.

Lamprosema camphorae sp.n. which Tams described in 1928, joins the edges of the leaf together and feeds inside the fold. The Notodontid, *Stauropus alternus* Wlk. is frequently common on camphor and *Helopeltis cinchonae* Mann. damaged individual seedlings in the nursery at Cameron's Highlands.

Aleurites Montana (China Wood-Oil).

Although numerous leaf-eating insects have been recorded on this plant, little damage has taken place. Probably the most common are the Limacodids, *Miresa albipuncta* H.S. and Parasa *lepida* Hbn. The Psychid, *Mahasena corbetti* sp.n. and *Nygmia corbetti* sp.n. which have also been recorded are new species described during the year by Tams. The Geometrid, *Boarmia transcissa lineataris* Wlk. has recently been recorded on this plant.

Tea.

The principal insects recorded during the year under review are the Capsid bugs, *Helopeltis cinchonae* Mann. and a *Helopeltis sp.*, an dthe aphid, *Toxoptera aurantii* Boyer.

Gambier.

The leaves of this plant are attacked by the Pyralid leaf-roller—*Margaronia coeruleiceps* Hamps. The hawk moth, *Deilephila hypothous* Cram., also is frequently much in evidence feeding upon the leaves and causing considerable defoliation. *Attacus atlas* L. has been occasionally found whilst the Capsid bug—*Helopeltis* (?) *sumatrana* Rpke. is sometimes in evidence sucking the young shoots.

Unidentified Sesiid borers causing considerable injury to the branches were observed in one area in Johore.

Palaquium gutta (Gutta-Percha).

The caterpillars of *Suana concolor* Walk. have been reported damaging the leaves of individual plants. The most important pest however is the leaf-rolling caterpillar of *Rhodoneura myrtaea* Drury. Occasionally *Sylepta balteata* F. causes some damage.

Extensive damage has been occasioned by a *Helopeltis* sp. killing the young leaves and causing leaf-drop. This insect is generally prevalent during the wetter months of the year.

A weevil—*Alcides* sp.—has been found damaging the collected seed of gutta-percha.

Hydnocarpus anthelminthicus and *Wightiana* (Chaulmoogra Oil).

The Limacodid, *Altha albiguttatus* Snell., has been collected feeding on the leaves of the former and *Belippa lohor* Moore, on the latter plant.

Zeuzera coffeae Niet. was found on several occasions at Serdang boring the branches of *wightiana* and was successfully treated by the application of Carbon bi-sulphide.

Derris ("Tuba").

The toxicity of *Derris* spp. has been under investigation. Records of the following additional insects damaging *Derris* have been made, *Eucosma conciliata* Meyr., *Eucosma balanoptycha* Meyr., *Mocis undata* F. and *Homona coffearia* Nietn.

Maize.

Scotinophara coarctata F. This Pentatomid is found particularly on *Oryza sativa* but also on *Zea mays*. A Chalcidoid egg-parasite has been obtained but has not been identified.

Phenice (*Proutista*) *moesta* Westw. A Derbiid found on the leaves of *Zea mays*, *Oryza sativa*, *Cocos nucifera*, *Elaeis guineensis*, *Saccharum officinarum*, and *Cymbopogon nardus* and probably many other plants. Its nymphal stages are said to be passed in rotten wood.

Pereyrinus maydis Ashm. A Delphacid on Maize which feeds in all stages on the young stems and the upper surface of the leaves is occasionally numerous.

Pyrausta salentialis Snell. This Pyralid is recorded from both stem and cob of maize, and in India is said to bore a species of *Polygonum*.

Pyroderces amphisaris Meyr. A Cosmopterygid attacking both inflorescence and cob of maize.

(ii) *Insects of Fruit Trees.*

Citrus.

Oranges were attacked by the Coreid, *Leptoglossus membranaceus* F., and the Pentatomid, *Rhynchocoris humeralis* Thnbg. A visit was paid to the Government Experimental Plantation where the former insect was found breeding on native grown cucurbits close to the orange trees. The cucurbits were removed and no further reports of *Leptoglossus* damaging oranges there have been received. *Rhynchocoris humeralis* Thnbg., was comparatively few in number. A visit was paid to Selama, Perak North, to investigate the cause of damage to oranges in that district. Numerous fruits had previously been received from which *Drosophila lurida* Walk. and *Drosophila* spp. emerged. The cause of the damage was found to be the Trypetid fly, *Chaetodacus ferrugineus* F. A poisoned bait and fumigation of the ground together with the burning of all infected fruit were recommended.

Work on *Prays endocarpa* Meyr. has been carried out throughout the year but success in breeding it through from egg to adult either in the laboratory or when caged on trees has not been obtained. A Chalcidoid parasite has been obtained from citrus fruits infected by *Prays*. Two parasites—one a Braconid and the other a Tachinid—have been recorded.

Drosophilids, among which *Drosophila lurida* Walk, is probably as numerous as any other species, emerge in large numbers from fruits attacked by *Chaetodacus*.

The Pentatomid, *Rhynchocoris humeralis* Thnbg. has been found on orange fruits, the Fulgorids, *Ricania pulverosa* Stol. and *Dictyophara pallida* Don. on the shoots of lime and orange, and the Coreids, *Riptortus linearis* F. sucking lime flowers and *Mictis tenebrosa* F. sucking the young shoots of limes. Occasional caterpillars of *Papilio achates* Cram. on the leaves of limes and pomeloes have been collected but the principal caterpillar pests are *Papilio demoleus malayanus* L. and *Papilio polytes* L.

Papilio helenus L. was collected on lime bushes at an altitude of 1900 feet. The Noctuid, *Parallelia palumba* Guen. was recorded on Pomelo for the first time.

The weevil, *Phytoscaphus leporinus* Fst. caused slight damage to flowers of lemons but *Hypomeces squamosus* F. was occasionally responsible for considerable injury to the leaves.

Musa Sapientium (Banana).

The leaf-roller, *Erionota thrax* L., was conspicuously prevalent throughout Malaya but no instance of its causing the death of the plant has been recorded. The caterpillars are frequently heavily parasitised by the Braconid, *Apanteles erionotae* Wilkn. The weevils, *Odoiporus longicollis* Oliv. and *Cosmopolites sordidus* Germ. have been found responsible for killing bananas, but although widely distributed seem to cause less injury in Malaya than elsewhere. The Arctiid, *Creatonotus transiens* Walk., and the Noctuid, *Prodenia litura* L., have been reported causing extensive damage in different areas. An enquiry concerning the Tingid, *Stephanitis typicus* Dist., has been received. In one area it was alleged to have inflicted serious injury.

Anona Muricata (Soursop).

The caterpillar of *Papilio agamemnon* L. has caused a certain amount of damage but *Attacus atlas* L. has been the major pest.

Achras Sapota (Chiku).

This plant is generally free from insects. *Rhodoneura myrsusalis* Walk., which is commonly met with on *Bassia latifolia* was found in some numbers damaging the leaves. The Trypetid, *Chaetodacus ferrugineus* F., has frequently been found damaging the fruits.

Psidium Guajava (Guava).

Attacus cynthia Dru. was found causing much damage on one occasion to this plant. *Attacus atlas* L. was also recorded from this plant and *Persea gratissima* (Avocado pear) during the year. *Chaetodacus ferrugineus* F. was bred from the fruits of the first named-plant.

Nephelium Lappaceum (Rambutan).

Considerable damage was done by the night-flying beetles, *Apogonia cribricollis* Burm., *Lepadoretus griseosetosus* nofr. and *Chaetadoretus bornensis* Kraatz.

(iii) Insects on Other Plants.

(a) *Vegetables.*

Tomato.

The fruit-fly, *Chaetodacus ferrugineus* F., has been the subject of enquiries. The Eel-worm, *Heterodera radicicola*, has been an agent causing the withering of plants.

Ipomæa Batatas (Sweet Potato).

The Coreid, *Homoeocerus serrifer* Westw., was collected damaging the shoots and stems of sweet potato and groundnut at Serdang. *Physomerus grossipes* F. was also commonly found on this plant. The caterpillar of *Omphisa anastamosalis* Guen. caused some damage to one area. The Pterophorid, *Alucita niveodactyla* Pag., was recorded for the first time. The weevil, *Cylas formicarius* F., inflicted severe damage to the tubers in one area.

Solanum Melongeanum (Brinjal).

The ant, *Solenopsis geminata* F., destroyed buds and shoots whilst the coccinellid, *Epilachna indica* Muls., the

Chrysomelid, *Rhaphidopalpa similis* Oliv., and the Pyralid, *Psara bipunctalis* F. were found feeding to a slight degree on the leaves. The principal pest, however, recorded during the year was *Leucinodes orbonalis* Guen.

The Coreid, *Anoplocnemis phasiana* F., by sucking the sap from young shoots inflicted slight injury and the Gelechiid, *Phthorimaea ergasima* Meyr. was obtained from the leaves.

Cucurbitaceous Plants.

Probably the most injurious insects to these plants which include Wax gourd, Snake gourd, Cucumber, Pumpkin. Loofah and Carilla have been the fruit flies, *Chaetodacus caudatus* F. and *cucurbitae* Coq. Both these Trypetids seem to confine their attention entirely to the fruits of cucurbitaceous plants causing considerable damage. No parasites have been bred with the doubtful exception of a Tachinid. Insects damaging the leaves have been the beetles *Ceratia* coffeae Hornst., *Rhaphidopalpa similis* Oliv. and *Ceratia atripennis* F., the two former were also obtained at Cameron's Highlands.

The Reduviid, *Sycamus leucomesus* Walk., has been found feeding on these beetles.

The Coreid, *Leptoglossus membranaceus* F., has been numerous on several occasions at Serdang on *Cucurbita maxima, Luffa acutangula, Momordica charantia, Trichosanthes anguina* and *T. palmata.*

(b) *Flowering Plants.*

Canna.

The insects causing most damage to the leaves are the beetles *Lepadoretus compressus* Weber., *Apogonia cribricollis* Burm. and an *Autoserica* sp.

The caterpillars of the Sphingid—*Acherontia lachesis* F. and the Arctiid—*Amsacta lactinea* Cram. are occasionally troublesome.

Zephyranthes and *Crinum.*

The blackish-white banded caterpillars of *Brithys crini* F. mine the leaves of the last-mentioned and feed on the

stems below the surface of the ground. Persistent hand-picking and, if necessary, spraying with lead arsenate should be practised.

Gardenia.

The slug-like caterpillar of *Altha albiguttatus* Snell. has occasionally occurred but the hawk moth *Cephonodes hylas* is more common.

Hibiscus.

Sylepta derogata F., the caterpillars of which roll the leaves, *Xanthodes transversa* Gn. and *Anomis flava* F., the caterpillars of which feed exposed on the leaf.

Dysdercus cingulatus F. A case of entire defoliation was due to an *Aleyrodid* (*Aleurocanthus* sp.) and mites prevented the normal unfolding and caused "blistering" of the leaves.

Coccids are always conspicuously present.

Orchid.

The white frothy secretions of the larvae of the beetle *Lema pectoralis* Baly. have attracted attention and enquiries have been received. The Geometrid caterpillar, *Boarmia fuliginea* Hamps., has been noted on the leaves.

(c) *Ornamental.*

Casuarina.

In addition to scale insects, the Fulgorid, *Lawana conspersa* Wlk., occasionally occurs in enormous numbers. The needles of the *Casuarina* are frequently bound together by the larva of *Agylla gateri* Tams. The very large caterpillars of *Streblote lipara* Tams. have been recorded on one occasion causing extensive damage to the needles of this plant.

Mesua Ferrea (Ceylon Iron Wood).

The Noctuid caterpillars of *Stictoptera subobliqua* Wlk. and *Simplicia marginata* Moore, have occasionally been collected.

Cassia Fistula.

This ornamental plant suffered considerably from the attacks of the caterpillars of *Catopsilia pomone* F., *C. crocale* Cram., *C. pyranthe* L. and *Terias blanda* Boisd., on one occasion entirely defoliated some plants.

Enterolobium Saman (Rain Tree).

Considerable injury was caused to this shade tree by caterpillars of the Noctuids, *Rhesala figurata* Moore. and *R. imparata* Wlk.

(iv) Insects of Stored Products.

Diocalandra (*Calandra*) *oryzae* L.

Silvanus surinamensis F.

Tenebrionoides mauritanicus L.

Tribolium castaneum Hbst. A Tenebrionid recorded from rubber-seed cake, stored Derris and rice.

Lasioderma serricorne F. This Anobiid is a serious pest of stored products, notably tobacco and cheroots.

Bruchus analis F. and *Bruchus obsoletus* Say. The former has been recorded from *Phaseolus radiatus* and *Cajanus indicus* and the latter from *Phaseolus vulgaris.*

Sitotroga cerealella Ol.

Dermestes vulpinus F. This Dermestid is universally distributed. It has been bred from preserved fish imported from China.

Trichophaga abruptella Woll. The larva of this Tineid has been recorded feeding on cloth and carpets. It is frequently responsible for damaging the cloth upholstering of cars.

Miscellaneous.

Martesia striata Linn. This Mollusc was found in timber at a wharf in the Straits Settlements.

Achatina fulica. Interest has been shown in this snail during the year and in addition to other places it has been recorded from Johore and Kelantan.

Thalassina anomala. This crab causes extensive damage to estate roads, drains and bunds in coastal areas. Poison baits have been tried with indifferent success.

Cheiromeles torquatus. This bat known to the Malays in Pahang as "Kelasar" was reported damaging padi by severing the ears. This bat is undoubtedly insectivorous. The examination of specimens revealed the presence of a few lepidopterous scales, the reactions for starch and hydrolysed cellulose were negative whilst the reaction for chitin was weak positive.

Ants in houses. During the year the well-known Argentine ant poison has been tried and on every occasion has proved successful in freeing houses from ants.

General.

An enquiry outside Malaya was received concerning the insects attacking *Solanum torvum* with a view to their possible introduction to control this weed in that Country. It was natural to find that its pests in Malaya were the same as those of the closely related plant, brinjal (*Solanum melongeanum*).

Leucinodes orbonalis Guen., *Epilachna indica* Muls., *Dacus ferrugineus* F. were recorded and it was hoped that *Phthorimea ergasima* Meyr., whose caterpillars bore the seed might be worthy of consideration to import, since about 60% of the berries were found to be attacked. Our records, however, show that the caterpillars of this moth—*Phthorimea ergasima* Meyr. mine the leaves of brinjal and also live inside the fruits of *Solanum verbascifolium* but it cannot be considered a pest in Malaya.

Information was also sought with regard to the parasites of *Tirathaba rufivena* Wlk. (The Greater Coconut Spike Moth) with a view to their possible importation. The recorded parasites in Malaya are the Ichneumonid, *Nemeritis palmaris* wilkn. and the Tachinid *Hemimaticera basifulva* Bezzi.

(Sgd.) G. H. Corbett,
Government Entomologist, S.S. & F.M.S.

6th March, 1929.

Field Division.

Annual Report for 1928.

I. Staff.

Mr. F. Birkinshaw from January 16th to June 28th and Mr. A. E. C. Doscas from June 29th acted Chief Field Officer vice Mr. F. W. South, acting Secretary for Agriculture.

Mr. J. Fairweather acted Agricultural Field Officer, Perak North, from June 29th vice Mr. F. Birkinshaw on leave.

Mr. F. R. Mason acted Principal Agricultural Officer, Johore, from April 6th to November 30th inclusive vice Mr. F. de la Mare Norris on leave. He acted Agricultural Field Officer, Perak South from December 5th vice Mr. Doscas. Mr. J. W. Jolly acted Agricultural Field Officer, Province Wellesley and Penang from April 6th vice Mr. Mason.

Mr. C. L. Newman took up the appointment of Agricultural Field Officer, Selangor, from January 1st vice Mr. R. B. Jagoe transferred to the Economic Botanist's Division. He acted Agricultural Field Officer, Malacca, from July 1st vice Mr. Fairweather.

Mr. J. A. Craig acted Agricultural Field Officer, Perak South, from June 5th and Agricultural Field Officer, Selangor, from December 5th.

Leave.—Mr. F. de la Mare Norris April 6th to November 30th and Mr. F. Birkinshaw from June 28th.

II. Estates Visited.

Area.	Estates.	By request.	Visited more than once.
Selangor -	18	10	5
Negri Sembilan -	8	1	1
Perak North -	5	5	1
Pahang West -	4	4	1
Perak South -	10	1	6
Penang & P. Wellesley	15	11	6
Malacca -	10	9	...
Johore -	163	17	11

The majority of estate inspections were for the purpose of control of pests and diseases. Other visits were connected with the cultivation of Oil Palms, miscellaneous food crops, coconuts, tuba root, tea, coffee, bananas and tapioca; the purchase of an orchard by Government, applications for land, identifying indigenous cover crops, leaf fire damage, export certificates for budwood, destruction of dead coconut palms, destruction of land crops, introduction of good strains of padi, export of rubber seed and collection of soil samples.

III. Rubber.

(i) *General.*

It is of interest to record that although the atmosphere of uncertainty caused by the announcement early in the year that restriction would cease on October 31st enforced a programme of rigid economy, the general maintenance of larger properties was well maintained, while the judicious distribution of coupons corrected any tendency on the part of small holders to disregard their responsibilities. Since the passing of the coupon however a general decline in the standard of maintenance has become apparent in small holdings throughout the country, while disease control has become increasingly difficult to enforce.

An American Oil Corporation interested in the manufacture of rubber seed oil created a market for rubber seeds in this country during the latter half of the year. The Corporation's decorticating plant is situated in Sumatra, but should sufficient support be lent to the venture by Malayan cultivators it is proposed to establish a local plant, in which event small holders will be enabled to participate. Owing to strict import regulations prevailing in the Dutch East Indies, a considerable quantity of material forwarded to Port Swettenham and Prai could not be passed as conforming to the standard set by the Dutch authorities, although acceptable to the Corporation for their purpose. A total of 122,178 bags were exported.

Very large quantities of budwood, budded stumps and selected seeds have been imported from Java and Sumatra

throughout the year. See Appendix A. Small quantities of seed and budwood have also been exported.

(ii) *Pests and Diseases.*

Tapping surface.

(a) *Mouldy Rot—(Ceratostomella fimbriata*, Ell. & Halst. (Elliott).

Dry weather generally during the first eight months of the year acted as a check to the development and spread of this disease. The general rains experienced during September however, produced prolific outbreaks in all areas where the disease had previously been established. The staff of the division has been severely taxed in endeavouring to regain control since the abolition of restriction. The universal eagerness to obtain maximum output requires the closest supervision in order to have cessation of tapping observed as an essential measure of treatment.

Black Stripe Phytophthora spp.

A few cases only of this disease were reported during the third quarter at Gombak in Kuala Lumpur district, and in the Kinta district of Perak. During the last quarter however Perak South became the centre of a wide-spread attack embracing the districts of Kinta, Batang Padang, Lower Perak and Sitiawan. The most virulent infections were centred in the Kinta district but yielded to prompt and efficient treatment. In the riverine mukims of Lower Perak an extensive infection was located. Lack of staff and easy transport, together with considerable flooding during December rendered supervision and control very difficult.

Collar Patch Canker (Pythium sp.)

This disease was present during the year on an estate near Batu Gajah. Treatment which included the destruction of some of the attacked trees was quickly put in hand and the disease controlled.

(b) *Stem Diseases (Corticium salmonicolor* B. & Br.)

Cases were reported from Perak, Selangor and most districts in Pahang West and three estates reported the presence

of the disease in Johore. The conditions in small holdings calls for no special mention.

Stem Canker.

A somewhat severe affection of young plants in a new clearing on Mentakab estate was investigated by the Rubber Research Institute.

(c) *Root Diseases* (*Ustulina zonata*).

This disease is reported to be very prevalent in the Muar district of Johore, and in the vicinity of the Pahang River in low lying and damp situations.

Fomes pseudo-ferreus and *Fomes lignosus.* Is fairly generally distributed throughout old established planted areas in each State, more especially Johore, Selangor and Perak.

An increase in the number of small holders devoting attention to the treatment of root diseases is generally reported.

IV. Coconuts.

(i) *General.*

With the exception of Johore and to a lesser extent Malacca, no appreciable expansion of planted areas has been reported during the year. In Johore exports have been well maintained, and are in excess of those for 1927. Extensions to planted areas have been made along the west coast.

The necessity of restocking the flood devastated areas of riverine mukims of Pahang is being urged, and every assistance given towards achieving this end.

(ii) *Pests and Diseases.*

Setora nitens Walk.

An outbreak of this pest was reported during July on three adjacent coconut estates in the Bagan Datoh district of Lower Perak. Young palms were attacked first and later older palms were invaded. The Assistant Government Entomologist visited the area at the end of July and suggested methods of treatment and control which took the form of hand picking the caterpillar from young palms, and spraying

those which could not be reached by hand. The outbreak suddenly ceased, and large numbers of dead caterpillars were found on and below the young palms, and it was considered that parasitism was largely responsible for the eradication of the pest. Further outbreaks occurred during September and November and were successfully controlled by hand picking.

During the first quarter this pest was found over a large area on an estate in Selangor on the Bernam river, and was successfully controlled by spraying with lead arsenate.

Marasmius sp. was again responsible for damage on a dwarf coconut estate in Perak North.

The affection known in Johore as Benut disease has not been so prevalent in the Benut and Kukub districts. Burning or burying attacked palms and the establishment of isolation trenches in diseased areas has been maintained.

Artona catoxantha, Hamps. Two outbreaks were reported from the South coast of Johore. The most serious attack was not discovered until considerable damage had been experienced, and the pest controlled by parasites.

Black Beetle (*Oryctes rhinoceros*). This pest is still prevalent in the vicinity of townships and villages where control measures are enforced during the ordinary routine inspection duties of the staff.

V. Padi.

(i) *General.*

(a) *Season 1927—28.*

With the exception of Malacca and Pahang West unfavourable weather conditions reacted against crops and yields are below average.

In Larut and the mukims of Selinsing, Semanggol, Parit Buntar, Brieh and Bagan Serai in Krian districts, and in parts of the Province harvesting was accompanied by rain with consequent loss.

In Pahang West the planted area was in excess of that of the previous season to the extent of some 7,221 acres. In many cases the flood detritus proved to be fertile and very suitable for padi cultivation, and good yields were obtained.

In Pahang East a severe drought lasting into September delayed planting, and floods during December did considerable damage to unharvested areas. Where the grain had set it is estimated that eighty gantangs will be obtained from damaged areas, but where the crop was immature a total loss will be sustained. 592 acres are reported to be harvested or undamaged, 935 damaged, and 519 destroyed.

Malacca experienced a satisfactory season and obtained average yields.

(b) *Season 1928—29.*

Unfavourable planting conditions were again experienced in the principal padi planting areas. Once established however the crops made favourable progress and prospects at the end of the year were better than anticipated earlier in the season.

Perak.—In Perak North prospects are considered to be good. Lack of rain and the low level of water in irrigating channels resulted in wide variations in the planting programme which was not complete till mid December. In Larut planting was late but the crop has made good progress Prospects in Kuala Kangsar are fair and with the exception of sawahs at Blanja and Saiong where extensive rat damage was experienced, crops should be up to average. The crop in Upper Perak is reported to be looking exceptionally well.

In Perak South the area planted is larger than in previous years with the exception of the riverine mukims of Lower Perak. Considerable expansion is reported from Kwang in Kinta district where new areas have been brought into cultivation. At Tanjong Malim the planting programme was up to time and practically all areas were cultivated. Owing to seed shortage in Lower Perak 929 gantangs of "Radin 2" and 50 gantangs of pulut were distributed in the river mukims; upkeep however was not good and rats did considerable damage. Flooding took place towards the end of the year but damage if any is not yet known. Work was well in hand in Batang Padang, and crops forward. Rain in November damaged an extensive area of hill padi.

Selangor.—Transplanting commenced in June but where irrigation facilities were lacking considerable delay ensued. As a temporary flood preventive measure the P.W.D.

"degraded" the irrigating stream in the Ulu Yam area causing much silting of padi land, and the loss of some fifty acres of crop.

Negri Sembilan.

With the exception of the Muar river valley planting was up to time and quickly concluded. Three to four months padi was planted in the latter areas. A new dam at Pantai was finished during the year and an extensive of cultivation in this area is anticipated. An increased area under cultivation is reported from Port Dickson where good crops of hill padi have been harvested.

Pahang.

Gloomy reports of the conditions in the river mukims of Pahang West have been received. Continued shortage of water resulted in late planting, scorching and a heavy pest incidence, and it is considered that yields will be decidedly inferior to the 1927—28 harvest. Several mukims have planted up areas of maize, tapioca and other food products to meet the shortage. The road mukims however, especially Ulu Cheka, Tanjong Besar and Budu in Lipis district, and Dong and Sega in Raub have made very satisfactory progress and yields will probably eclipse those of the previous season. At the end of the year harvesting was in progress in Temerloh and Bentong districts and many mukims of Lipis district. News of a serious flood was to hand on December 27th, and it is understood that many areas below Kuala Tembling have been badly flooded and it is anticipated that considerable loss will be experienced in areas where harvesting was not completed. Conditions in Pahang East were dealt with under the heading Season 1927—28

Province Wellesley.—Planting was very late, but the crop has made good progress and prospects at the end of the year were encouraging.

Malacca.—An increased area is reported to be under cultivation, prospects are good and flood damage negligible.

Johore.—Increased interest in padi cultivation is maintained and a steady extension of planted areas reported. Comparatively large areas have been planted at Kota Tinggi and Segamat, while dry padi has been extensively planted between coconuts and areca nuts around Batu Pahat and Muar.

Good progress has been made at the padi area near Mersing where facilities to irrigate some three hundred acres are nearing completion. Satisfactory progress is reported from Ayer Papan where selected varieties have been planted.

(ii) *Pests.*

Mole crickets. (Curtilla africana) attacked nurseries at Redang and Ketior at Parit in Perak.

Scotinophara coarctata. An area at Layang Layang in Perak where water control was not available was damaged beyond recovery by this insect. A certain amount of damage was reported from Pahang East while at Rantau Panjang mukim Semantan, and Tok Embun mukim Mentakab, Temerloh district; and at Gandong, mukim Benjom, and throughout mukim Ulu Cheka in Pahang West the pest was also established but quickly controlled by flooding without much damage, except at Tok Embun where water was not available. The pest also appeared in considerable numbers at Kuang in Selangor but was almost immediately controlled by heavy rains.

Sogata pallescens was present in various areas in the district of Krian. Attacked plots were drained and kept dry for several days and the pest quickly disappeared. Damage at Kajang Paya in Selangor was minimised by similar treatment.

Leptocorisa acuta appeared in large numbers at Senaling in Kuala Pilah district. The cultivators were turned out by the District Officer, and under the supervision of officers of the division the pest was eventually controlled.

Sesamia inferens and *Diatraea auricilia* were responsible for extensive damage at Beranang and to a lesser extent at Kuang and Kampong Kuala Pajam in Selangor. They were also present at Tanjong Malim in Perak South.

(iii) *Organised Rat Destruction.*

(a) *Krian.*

The campaign in this area has been energetically pursued, and damage to padi is reduced to a minimum. The following table shows the catches for 1927—1928.

	1927.	1928.
Cultivators ...	256,906	536,493
Schools ...	333,617	318,719
P.W.D. ...	252,262	49,432
	842,791	904,644

(b) *Province Wellesley.*

Since the appointment of a Rat Destruction Officer on July 23rd., the work in this area has yielded very encouraging results. Regular and prompt payment for tails appears to be an essential factor, otherwise interest quickly flags, and catches rapidly decrease. The services of a whole time officer meets this requirement, while general supervision and organisation are maintained.

Schools and Tamil road coolies have yielded the largest proportion of catches. Up to the present participation in drives has made no appeal, but attempts to popularise this form of destruction will be continued.

The Agricultural Field Officer reports that rat damage in nurseries was not excessive and that since transplanting damage has been scattered and only over a limited area It is the general opinion of cultivators that the campaign has greatly reduced damage by rats.

During the year 509,151 tails were paid for, the average cost working out at 1.785 cents per tail.

VI. Minor Crops.

Oil Palm.—Continued interest is being shown in this crop and increased developments especially in Johore, Perak, and possibly Pahang may be confidently anticipated.

Coffee.—Areas under this crop are reported to be in good condition and yielding satisfactory returns. Increased interest is reported from Pahang East and the Dindings. In Johore the crop is now fairly extensively cultivated the principal centre being Paloh.

Cloves.—The cultivation of this crop in Penang is considered to be diminishing.

Pineapples.—In Johore satisfactory crops have been obtained and output for the year is in excess of previous years with the exception perhaps of 1925. Three new factories were in course of erection during the year.

Interest in this crop in Selangor is centred around Klang where a local factory absorbs the bulk of the crop. Prices however are usually low.

Tapioca.—Production in Johore shows a slight increase. It is extensively grown as a catch-crop with rubber. Enquiries have been received as to its suitability as a catch crop with African oil palm, fruit trees, coffee etc. A new factory has recently been opened at Kulai.

Tea.—Three small areas in Negri Sembilan are producing a low grade product. An area of approximately 150 acres is cultivated by Chinese gardeners in Selangor, and three grades are put up for local sale. No further extension of cultivated areas has been reported, but preparations are being made for production on a large scale in Selangor, while enquiries in Pahang have also been made.

Tuba.—Former plantings in Johore River area are gradually being removed. The main areas are now situated at Layang Layang and Senai. About 250 acres are interplanted with rubber in Negri Sembilan. Fairly considerable areas are still cultivated in Perak South.

Gambier.—Although this crop is still attracting attention in Johore, areas in other States notably Negri Sembilan and Pahang West are being cut out, as a result of low prices ruling.

Areca Nut.—An increased output is reported from Johore where comparatively large extensions have recently taken place.

Bananas.—Considerable areas of this crop are established in Negri Sembilan, Selangor and Perak, where it is used as a catch crop.

Vegetables and food crops.—A considerable extension of areas under miscellaneous food crops is reported from Perak South where quantities of seed have been obtained by the department and sold to cultivators at cost price. Areas in Pahang East are uniformly bad.

Sago.—An appreciable export of sago is still maintained from Johore but areas of the palm have recently been cut out in the Kukub district.

Fruit.—The mid season fruit crop was satisfactory throughout, but towards the end of the year, due no doubt to unfavourable weather, crops generally were extremely poor and sparsely represented in the markets.

VII. Miscellaneous Pests and Diseases.

Water Hyacinth (Eichhornia crassipes).

The departmental gang of coolies was employed on the lower reaches of the Perak river during the period April 23rd July 28th. All traps in Perak South have been well maintained throughout the year.

In Perak North the gang was employed in the Krian irrigation area during January and February, and up to the time of transfer to Perak South was engaged in work around Taiping. From the end of July to the close of the year the Krian district was dealt with.

The departmental gang in Province Wellesley was employed throughout the year and effectively controlled the pest throughout that area.

Giant Snail. (Achatina fulica).—There was no particular activity during the dryer periods of the year. An increase is reported from Ipoh while Teluk Anson and Batu Gajah have also become infested. In Selangor the snail has been reported from Kuala Lumpur and Rasa, while it has also appeared in Kuala Lipis in Pahang. It is now well established in Johore Bahru, and has also been reported from Muar and Kota Tinggi, having been introduced into the latter place on pot plants brought from Singapore.

Lallang and Blukar.—While the coupon was in vogue a very satisfactory maintenance was achieved. During

August however a decision in the Supreme Court of the Straits Settlements ruled, that Lallang and Blukar did not constitute a pest within the meaning of the Ordinance. Pending a settlement of this point of law no further action has been possible,, and the general position at the end of the year was extremely unsatisfactory.

Panama Disease.—Panama disease of bananas has been confirmed from Jelebu in Negri Sembilan, and Tapah in Perak South.

VIII. Experimental Stations.

(a) *Padi Stations.*

Perak. Talang Test Station, 1927—28.—The yields throughout the station of Seraups No. 1, 15, 36, 48, 52, were very satisfactory and varied from 480 gantangs per acre for Seraup No. 15 to 735 gantangs per acre for Seraup No. 1. The highest yield obtained from unselected seed in the immediate vicinity of the station was 350 gantangs per acre.

Radin 13 which was planted as the main crop gave a mean average yield per acre of 527 gantangs.

Serendah 741 yielded only 365 gantangs per acre.

1928—29. The same planting scheme has been adhered to. Manurial trials have been extended.

Pahang. Dong Station, 1927—28.—Very satisfactory results were obtained and valuable information recorded.

1928—29. This crop looks extremely promising and and should eclipse the results of the previous season. Seraup Kechil 36, and Padi Negri, the former from Krian and the latter a local padi have displaced the two Malacca foundation stocks 824 and 746 in this year's planting. During 1929 it is hoped to commence distribution of approved stock, together with preliminary selection work on proved local varieties.

Arrangements are being made for the establishment of a test station at Temerloh where an area has been provisionally chosen for this purpose.

Pekan Station.—Work on this station was greatly hindered by dry weather. Transplanting of wet padi was delayed until the end of July owing to previous failure. The dry padi was sown at the end of June, and has made fair progress. On the dry padi plots grass cuttings and vegetable rubbish was applied to the land a month before ploughing and was then thoroughly incorporated in the soil in three ploughings. The object of this treatment was to test whether such rufuse so easily obtainable was of sufficient manurial value in itself. The results so far are very encouraging; a fair stand of padi being obtained, while tilth is much improved.

A slight departure was made from following local methods as far as possible in the case of wet padi. This was to ascertain if wet conditions after the grain had set had any influence on the longer maturation period of certain padis in Pahang East. In the case of Nachin Puteh grown from seed obtained in 1927 from Malacca, where it is a six months variety, under local conditions of husbandry was found to be six months and twenty seven days. This year however the plots were drained when the grain had swelled, and the crop was harvested in exactly six months.

Damage by flood was again experienced.

Province Wellesley. Pekan Darat Station.—The 1928—29 Crop is being conducted along the same lines as previous years. The appearance at present is reported to be fair, but certainly better than surrounding areas. Arrangements are in hand to obtain a more suitable area, as water control on the present station is very unsatisfactory.

Glugor Tests.

The management of Glugor estate, Penang, undertook to test selected strains of padi on their sawah land. The work was well conducted and two relongs were planted with seed supplied by the Economic Botanist and consisting of Seraup Kechil Nos. 36, 48, 15 and Radins Nos. 2, 4, 7, and 13. Surplus nursery stocks were distributed to adjacent cultivators, and the total area planted with selected seed amounts to some twenty relongs.

Malacca. Pulau Gadong Station.—1927—28. The crop was badly damanged by rats and no conclusions could be

drawn from the figures obtained. The Pure Lines however were not affected, and the usual records were obtained for the third year.

1928—29. The crop has done fairly well so far. Acid water flooding in from adjacent swamp land caused a considerable set-back to the whole station.

Selangor.—Small experimental plots have been conducted during the year at Kajang Paya, Bukit Cheraka and Tanjong Karang.

Radin No. 13 and Seraup No. 36 were planted at Kajang and have made good growth. The plots suffered damage from stem borers.

At Bukit Cheraka where Seraups Nos. 36, 15, and Radin Nos. 7 and 13 were planted, unfavourable conditions, and neglect by the contracting cultivator have combined to render valueless any results that may be obtained.

A salt resisting variety from Kedah was planted at Tanjong Karang but was completely destroyed by flood.

(b) *Other Stations and Experiments.*

Kuala Kangsar Fruit Station.—A crop of approximately 16,000 oranges was harvested and sold for $170.

A few selected varieties of Rambutan, Pulasan, Pomelo and Chiku were planted towards the end of the year. Cover crops have been retained for seed purposes, and green dressings for Talang padi station.

Talang Coconut Station.—As dwarf coconuts were making slow progress on this station it was decided to replace them with a selected tall variety. The cover crop of *Mimosa invisa* was dug in, and the land cleared limed and changkolled ready to receive the new material.

Green Dressing Experiments on Slimed Land.—*Tephrosia candida* and *Mimosa invisa* continued to make good growth throughout the year.

Negri Sembilan Fruit Station.—The unplanted portion of this station, which is on a slight slope, has been cleared, bunded, and planted with various cover crops.

The budding of citrus on pomelo stock was commenced during the year, but was not successful owing to dry weather.

Kuala Lipis Fruit Station.—Soil improvement by green manuring, and the laying down of a necessary drainage system were attended to during the year. Citrus trees are reported to be doing well although requiring much attention to cope with pests. The station was almost completely submerged on December 27 and 28.

The experimental work on cultural operations connected with the management of cover crops in Perak South has been maintained. Girth measurments are taken every three months, and moisture determinations taken from time to time.

IX. Other Instructional Activities.

The Agricultural Field Officer, Pahang East delivered lectures at the Pekan and Kuantan clubs on the subject of garden soils. Short lectures were also given to school children.

In Temerloh an inter-kampong competition inaugurated by the District Officer was a distinct success. Prizes were awarded for the best vegetable garden, combined with cleanliness and sanitation of dwellings.

School Gardens.—Routine inspections have been carried out during the year and members of the staff have acted as judges in several competitions. Implements, fencing and planting material have been supplied.

X. General.

The new "Plant Importation Rules 1928," and "Plant Notification Rules 1928," Johore came into force during the year.

Shows.—The Malayan Exhibition was held in Ipoh from August 3rd to 6th. The number and quality of agricultural exhibits were well below expectations.

The Lower Perak Agri-Horticultural Show was held in Teluk Anson on September 9th and was probably the best of its kind ever held in the district. Considerable interest was shown by small Asiatic cultivators, especially Malays.

The exhibits in the fruit and vegetable sections were large, varied, and of a commendable order.

A successful two days' show was held at Taiping on August 19th and 20th. All classes and sections were well supported. Great interest was displayed in the sections dealing with padi and poultry.

The Malacca branch of the Malayan Agri-Horticultural Association held its annual show on July 21st and 22nd. Fruit and vegetables were well represented, but other agricultural sections were not up to general expectations. In the hope of exciting more general interest, the inauguration of district shows is contemplated in the future.

Examinations of several large areas of land have been made, and reports on the suitability for the cultivation of various crops, notably padi and oil palms submitted.

Examinations for promotion from Junior to Senior Agricultural Assistant were held during the year. Four members of the division presented themselves but were not successful.

Distribution of Planting Material.—Apart from material supplied to schools, 9,449 fruit seedlings, marcots or grafts were supplied to small holders from nurseries in Pahang. Small distributions were also made from Seremban.

A. E. Coleman Doscas,
Ag. Chief Agricultural Field Officer,
F.M.S. & S.S.

Kuala Lumpur,
February, 1929.

APPENDIX A.

PLANTING MATERIALS IMPORTED FROM THE NETHERLANDS EAST INDIES DURING THE YEAR 1928.

Port of Entry.	Budwood in metres.	Seeds.	Budded Stumps.	Oil Palm Seeds.	Coffee Seeds.	Coffee Seedlings.
Singapore -	9,260	359,110	5,245	100,000	133 1/3 lbs.	1,024
Penang -	9,340	21,000	10,000	1 case	...	...
Port Swettenham -	12,455	7,000	10,108	...	10 lbs.	12
TOTAL.	31,055	387,110	25,353	100,000 & 1 case.	143 1/3 lbs.	1,036

Division of Mycology.

ANNUAL REPORT FOR 1928.

Palm Diseases.—The situation with regard to the puzzling problem of Palm diseases in Malaya has been considerably clarified. Observations made during the year on a Dwarf Coconut Estate and a Tall Coconut Estate led to conclusions which receive more support every month. A general account of the whole of the Palm disease investigations was written up and published as a double number of the Malayan Agricultural Journal, September—October Nos. 9-10, 1928.

The common association of a new species of *Marasmius*, named *Marasmius palmivorus* Sharples, with diseases of African Oil Palms, Dwarf Coconut Palms and Tall Coconut Palms has been proved and the method by which the fungus accelerates defoliation in false "Bud-Rot" patches explained.

Since starting to write up the work further supporting evidence has been obtained which clears up the position regarding "Bud-Rot" caused by Lightning-Strike. In August last a questionnaire explaining the difficulty was sent out to thirteen Coconut Estates, and the Managers were asked to co-operate by noting when lightning storms occurred in close proximity, and the date when patches of dead and affected palms were observed. Six replies have been received and visits made to verify the information. In all these cases, patches of affected palms were found, three to seven days after the storm, some in places near to bungalows or office buildings where it would be impossible to miss noting any occurrence of the kind. Other cases have been notified which were observed visually by trustworthy observers, and I have no further hesitation in stating that Lightning is a factor of importance in the causation of palm diseases, more especially on Tall Coconut estates. The affected areas were all the same, two or three palms killed outright and the neighbouring surrounding 8-12 trees slightly affected, showing the usual broken or tipped leaves.

An important part of this work will be the discovery as to whether the larger areas of Tall Coconuts, in which 50-200 trees in a solid block are affected, can be attributed to the

same cause of Lightning. Up to date there is no direct evidence to support this view, although the symptoms shown by the affected trees in these larger blocks are similar in every respect to those in the smaller, proved Lightning Strike patches. In the last proved case, however, during one short storm three small patches were affected. There had been no further lightning storms between the date the storm took place, and the date the affected trees were found. Two patches were found at a distance of five chains apart and the third some seventy chains away from the other two in a N.W. direction. There is every reason for stating that all three patches were struck during the same storm, whether simultaneously by the same flash or otherwise, it is impossible to say. But if the three patches could be consolidated in one area, the number of trees affected would have approximated to the number of trees affected in a typical larger area. The capricious effects of Lightning are well known and it is tempting to regard Lightning as the initiating cause of the whole of the phenomena under investigation; however, until definite evidence is forthcoming, the initiating cause in the larger affected areas of Tall Coconuts must be regarded as non-proven.

The findings are of great importance to Malaya in so far that the evidence obtained justifies the statement that it is probable that no definite form of epidemic Bud-Rot, caused by a parasitic organism exists in Malaya. Perhaps, of almost equal importance is the fact that Malayan observers can now deal confidently with particular diseases, without risk of being side-tracked by phenomena which are apart from the investigation in hand.

Oil Palms.

Marasmius palmivorus Sharples was obtained from Oil-Palm estates in Selangor where it caused damage to the ripe fruit. The fungus was more common in damp humid areas than in dryer ones. Close planting and insufficient pruning increases the humidity and favours the growth of the fungus. On palms where the decaying, non-pollinated, bunches were not removed and other debris was allowed to lie around on the ground, the fungus was vigorously attacking the mature fruit bunches. The fungus was fruiting profusely and appeared to be spreading rapidly.

A Stem-Rot was examined, with which White Ants and a *Thielaviopsis* sp. was associated. This stem-rot, with which White Ant attacks are linked up, appears to be a rather serious matter, and one which requires attention in order to determine whether the losses are directly due to the insect attacks. If the insects are primarily responsible, the only preventive measures worth adopting are those of clearing timber as thoroughly as possible.

A root disease, with which a Ganoderma sp. was associated, was examined on one estate; reports of similar trouble and similar specimens were received from two other estates. The trouble was not serious, only three trees being killed.

Fomes lignosus Klotzsch, has been found growing on the old pruned leaf-bases at soil level, but no damage was done. This finding is interesting as this fungus has recently been reported to be the cause of a stem-rot of Oil Palms in Sumatra.

The root disease, with which the Ganoderma sp. (supra) was associated, in one case appeared to have originated from a large, decaying jungle root. The affected roots of the oil-palm were growing through this rotting jungle root, and the majority of the larger ones were decaying with a brown rot. The jungle root contained the same mycelium as the Oil Palm roots. The fungus had passed up the stem of the palm and the decay was evident to within a couple of feet of the crown. All the stem tissue from the base to half-way up the stem was involved, but near the limit of decay the central tissues were sound and bounded on both sides by diseased tissue. The hyphae in the tissues at the extreme margin of spread were similar to those found in the roots. Isolations from the margins yielded brown mycelium similar to that found in the tissues; the fungus grows well on Agar media and blocks of Oil Palm tissue. No fruit-bodies have developed up-to-date. Inoculations have been made with this fungus but the results are not yet to hand.

A *Thielaviopsis* sp. has been isolated from a decay of pruned leaf bases. If young leaves are pruned too early, the leaf bases remaining attached to the tree are liable to decay with a soft-rot which gives off the characteristic odour associated with attacks of *T. ethaceticus*. The pruned surface turns mauve-grey in the centre, due to the presence of this fungus, and the tissues disintegrate. The fungus appears to

die out before reaching the stem-tissues, and so far, no penetration of the stem-tissues has been observed.

Attention has recently been directed to symptoms shown by the falling out of nearly ripe fruits or by the fact that individual fruits can be easily pulled out before maturity. Preliminary investigations show a discoloration of the tissue of the fruit stalk which seems to pass into the stem tissues.

Areca Palms.—The definite association of *Polyporus ostreiformis* Berk. with certain symptoms of disease in Areca palms has been noted in previous years. An attempt definitely to prove the cause by inoculation experiments will be made when time permits.

Phytophthora species.—Twenty one species of *Phytophthora* were under study. Of these, eight were obtained locally; six being from bark and fruit diseases of *Hevea,* one from a wilt of Sireh (*Piper Betle* L.) and one from a disease of Roselle fibre (*Hibiscus sabdariffa* L. var. *altissima*).

Three species of *Phytophthora* were isolated from Black Stripe disease of *Hevea* i.e. (1) *P. palmivora* Butl. (*syn. P. faberi* Maubl.), (2) *P. meadii* McRae, (3) A new species. Two species of *Phytophthora* and one species of *Pythium* were isolated from Patch Canker of *Hevea* i.e. (1) *P. palmivora* Butl. (2) An undetermined species (3) *Pythium* sp. (*P. complectens* Braun?). This *Pythium* sp. and the new species of *Phytophthora* were also isolated from diseased pods of *Hevea.*

Inoculations with all the above mentioned species proved that they were capable of causing the diseases from which they were isolated, and, in the case of the *Phytophthora* species, that each one was capable of causing Black Stripe, Patch Canker and Pod-rot. Certain other species of *Phytophthora* including *P. palmivora* Butl. from Coconut and Cotton, (West Indies), and from Coconut (India); *P. parasitica* Dast. from Tobacco (Sumatra), and Castor Oil (India) and from Roselle fibre (Malaya), and a species from *Piper Betle* L. (India), are capable of causing Black Stripe and Patch Canker of Hevea if inoculated into the bark.

The species responsible for the wilt of *Piper Betle* L. in Pahang has been identified as *P. colocasiae* Rac.

Pythium species.—Three parasitic species have been isolated :—(1) *P. complectens* Braun? from Hevea, (2) *P. splendens* Braun from Begonias, (3) *P. aphanidermatum* (Eds.) Fitz. from Zinneas and Amaranthus plants.

Hibiscus sabdariffa L. var *altissima* (Roselle fibre).—A disease of this crop has been recorded in previous reports, but it was only in this year that the casual organism (*Phytophthora* sp.) was isolated. The disease starts as a rule at soil level, and is characterised by a blackish brown discoloration which extends up the stem often to a height of two feet. The discoloration is due to the presence of fungi and bacteria in the tissues, following the advancing mycelium of the *Phytophthora* sp. which can be found in the cortex some distance in advance of the edge of the discoloration on the stem. The disease is serious in soil which is not properly drained. Under such conditions more than 60% of the plants may be infected. The fungus is very similar to a strain of *P. parasitica* Dast. received from India and to a strain of this species from tobacco (Sumatra).

Sclerotium Rolfsii Sacc.—Strains of this fungus were studied and an article was published in the Malayan Agricultural Journal. Tomatoes were recorded as another host of this fungus in Malaya.

Rice Diseases.—There were no serious diseases of rice reported during the year. Some diseased plants were examined and found to be blackened at the base. A *Thielaviopsis* sp. was isolated, but proved to be only slightly parasitic when inoculated into young seedlings of seraup 15.

Banana Diseases.—The intensive study of Banana diseases was continued during the year. As mentioned in previous reports, this study is one of primary importance from an Imperial point of view. The disease of Bananas, known as Panama Disease, is causing great losses in the British Colonies which rely upon this commodity as their chief export.

The cause of the disease is a fungus, named *Fusarium cubense* (Erwin F. Smith). A Fusarium fungus similar to *Fusarium cubense*, was isolated from diseased banana (Pisang Embun) suckers obtained from Titi, Negri Sembilan, during the early part of January. Cultural and morphological characters of this *Fusarium*, and the type culture of *F. cubense*

(imported from Manila) agree in many respects. Comparative inoculation experiments have been carried out with these two Fusaria together with a Fusarium isolated from diseased "Pisang Restali" suckers in Johore. Of the three Fusaria, the one from Titi shews the greatest dissimilarity in culture, owing to the production of a much lighter colour and stronger odour when grown on steamed rice, and also in the production of blue-black sporodochia on steamed potato plugs.

Preliminary inoculations with the Fusarium from Johore on semi-mature Pisang Restali, made on October 14th 1927, showed positive results on January 30th 1928; the controls remained unaffected. The Fusarium was re-isolated from the diseased plants, grown on steamed rice and re-inoculated into other Pisang Restali suckers. These inoculations were carried out on semi-mature suckers and positive results were obtained three months later. Similar successful inoculation experiments have been carried out on Pisang Embun.

Detailed inoculation experiments were carried out on "Pisang Embun" and "Pisang Restali" and the native species *Musa Malaccensis* and *Musa Violescens* on February 12th, with the two Fusaria from Johore and Titi, and also the type species from Manila. Twenty five months old suckers of each of the varieties, Pisang Restali and Pisang Embun were inoculated, together with twelve suckers of *M. malaccensis* and six suckers of *M. Violescens*. These suckers are just approaching maturity and symptoms of Panama Disease are present on one Embun sucker inoculated with the Fusarium from Titi, also on two Embun suckers inoculated with the type culture of *Fusarium cubense* from Manila. None of the controls up to the present time have shown any symptom of Panama Disease.

The preliminary inoculation experiments, which were started about a year ago, in connection with Panama Disease, now show that of the fifteen varieties of bananas worked with, Pisang Embun and Pisang Restali are definitely susceptible to Panama Disease, and that the disease has been transmitted through the rhizomes of the parent to the daughter suckers.

Indications of a wilt were present on one of the inoculated suckers of Pisang Kelat and Pisang Awak Legor. From the discolored vascular tissue of the pseudostem a Fusarium species, similar to *Fusarium cubense*, was isolated from each

sucker. The internal symptoms of Panama Disease were not typical within these two varieties.

Bacterial inoculations were carried out on Solanaceous plants with a bacterium isolated from bananas; this organism was found associated with a disease on plants grown in Johore. The bacterium was isolated from the gummy exudate of a banana sucker, affected with a wilt disease which appears to be similar to a bacterial banana wilt disease recorded from Trinidad by Ashby. The bacterium isolated from the diseased banana sucker in Trinidad is similar to *B. solanacearum*, and inoculations with the bacterium from diseased banana tissue, on solanaceous plants, have given successful results in Trinidad. Two preliminary inoculations with the bacterium from Johore were successful.

Various saprophytic species of Fusaria have been isolated from the decaying leaf bases and from the out-side of the pseudostems of many varieties such as P. Embun, P. Restali, P. Susu, P. Kapas, P. Talam, P. Lilin and from P. Rajah Udang. The only Fusarium similar to *F. cubense* which has appeared growing in a saprophytic state, has been found on P. Embun and P. Restali only. According to Reinking and Wollenweber the fungus *F. cubense* appears to exist in four forms which are classified as follows :—

Forma 1—Saprophytic form producing a benzolic odour.

Forma 2—Saprophytic form without odour.

Forma 3—Parasitic form with odour (cause of banana wilt).

Forma 4—Parasitic form without odour (synonym *Fusarium cubense* var *inodoratum*, Brandes).

Nos. 2, 3 and 4 of the above appear to be present in Malaya according to isolations, and further soil isolations will possibly show that Forma 1 also exists. Final proof that the above saprophytic forms are present in this country can be obtained only by means of comparative inoculations with the parasitic forms. These inoculations will be carried out shortly.

Other fungi which have been conspicuous amongst the fifteen varieties of bananas, used in connection with Panama Disease, are a *Trichothecium* species and a *Marasmius* species. The former grows vigorously as a saprophyte on the leaf

bases of P. Talam and P. Susu and produces thick sporodochial masses, which "*en masse*" resemble the sporodochia produced by *F. cubense*. On P. Rajah Udang and P. Rajah the Marasmius species appears to be semi-parasitic. The poor growth conditions in the initial stages caused the suckers to become weakly, and an opportunity was thus afforded for the rapid spread of the fungus. The same Marasmius species *M. palmivorus* (Sharples) is the cause of a disease of Coconuts and Oil Palms (Supra).

Twenty four of the following varieties of bananas have been planted out at Jelebu in an area affected with Panama disease. P. Serendah, P. Restali, P. Kelat, P. Mas, P. Rajah P. Hijau, P. Embun, P. Rajah Udang, P. Talom, P. Laing, P. Boyan, P. Embun Buaya, P. Awak Legor, P. Awak Betol, P. Lemak Manis, P. Nangka, P. Mundan, P. Keling, P. Abu, P. Sevaly, P. Batu, P. Lilin, P. Jari Buaya, and P. Susu. Twelve suckers of each variety were used. Six suckers of each of these varieties have also been planted out on virgin land.

Six suckers of each of the above varieties have been planted out at the Government Experimental Plantation, Serdang, and inoculated by means of the "Spore Suspension" method. Three suckers of each variety were inoculated with the type culture of *Fusarium cubense* from Manila and three suckers of each variety were used as controls. The chief object of these experiments is to compare the natural method of inoculation with the artificial method, under varied conditions. Up to the present time, the suckers appear to be growing satisfactorily and have shewn no symptoms of disease.

An outbreak of Panama disease has recently occurred in Perak. A Fusarium sp. has been isolated which is similar to the one isolated from suckers affected with Panama disease at Titi, the only difference being that in culture, the Perak fungus does not produce a benzolic odour while the latter does. The Perak fungus appears to be a variety of *F. cubense* i.e. *Fusarium cubense* var. *inodoratum*. According to Brandes this variety can only be distinguished from the latter by the absence of a benzolic odour when grown on steamed rice.

A series of bacterial inoculations are being carried out, at the present time, with a bacterium often associated with *F. cubense* in culture. This is a yellow bacterium and ap-

pears to be somewhat similar to the bacterium (*Pseudomonas celebensis*) isolated by Gaumann in Java from P. Rajah bananas; these plants were affected with a vascular disease which, according to its internal and external symptoms is very similar to Panama Disease. A few preliminary bacterial inoculations have been carried out on the leaves and stems of P. Rajah but up to the present time no positive results have been forthcoming. Gaumann claims to have obtained positive results from his leaf inoculations within two weeks, but leaf inoculations carried out here over a month ago, are still negative.

Fusarium sp. on Chillies.—A disease of Chilies in which the leaves fall and the flowers wither, was examined. Some of the roots were found to be diseased, and a Fusarium sp. was isolated. Inoculations on unwounded plants were inconclusive.

Rhizoctonia sp. on Groundnuts and Potatoes.—A species of Rhizoctonia was found associated with a disease of Groundnuts and with a disease of Potatoes, the latter from Fraser's Hill.

Leaf Disease of Sisal Hemp.—A leaf disease of Sisal Hemp has been examined. As a result of this disease, fibre extraction is seriously interfered with, and only short fibres can be obtained from affected leaves. The important fungus appears to be a species of *Fusicoccum* (Corda).

Hydnocarpus Wightiana.—This plant suffers from a type of Die-back; affected plants usually show diseased roots.

Cinchona.—Cinchona plants showing root disease have been received from Cameron's Highlands. Diseased leaves of *C. ledgeriana* show an interesting Ascomycete probably a species of *Parodiella*. But for the absence of an "ostiole" to the Ascus, the fructifications closely approximate to the measurements given for *Mycosphaerella Thea* K. Hara, a fungus which causes a leaf disease of Tea.

Cladosporium fulvum.—This fungus was found causing damage to the leaves of Tomato Plants grown in Cameron's Highlands.

Tea leaves, with spottings, from Cameron's Highlands were found to be attacked by *Phyllosticta Thea* (Spechnew).

Kapur.—Kapur seedlings (*Dryobalanops aromatica*) were attacked by *Gloeosporium alborubrum.*

Bakau.—Bakau seedlings (*Rhizophora mucronata*) were attacked by a *Cytospora* sp.

Roses.—Specimens of Leaf Blotch caused by *Actinonema Rosea* (Lib.) Fr. were sent in for examination. A *Phragmidum* sp. probably, *P. subcorticum* was received from Penang. The variety effected was "Maman Cochet" and it seems impossible to grow this variety successfully in certain parts of Malaya because of the attacks of this fungus.

PUBLICATIONS.

Sharples, A.—Palm Diseases in Malaya. M. A. J. (Double Number). Vol. XVI, Nos. 9—10, 1928.

Thompson, A.—A preliminary note on Phytophthora spp. found in Malaya. M.A.J. Vol. XVI, No. 2, 1928.

Thompson, A.—Notes on *Sclerotium Rolfsii* Sacc. in Malaya. M.A.J. Vol. XVI, No. 2, 1928.

Ward, F.S.—Preliminary report on *Fusarium cubense* causing Panama Disease in Malaya. Vol. XVI, No. 3, 1928.

A. SHARPLES,

Government Mycologist,

S.S. & F.M.S.

January, 1929.

Division of Soils & Plant Physiology.

ANNUAL REPORT FOR 1928.

STAFF.

The staff of the Division at the end of the year was:—

Plant Physiologist (in charge Division)	... Mr. W. N. C. Belgrave
Assistant Chemist (Soils)	... Mr. J. H. Dennett
Junior Agricultural Asst.	... Haji Abdul Wahid
Do.	... Inche Ahmat bin Indot
Do.	... Inche Jalaludin
Do.	... Inche Mohd. Shafie b. Taib

Six Laboratory Attendants.
Two Peons.

WORK.

The work of the Division continued to be on soils, and the major portion of our time was spent on the continuation of the soil survey Cheras—Klang—Coast. As the selection of this area has been criticised on the score that it covers land already thoroughly well known it may be appropriate to quote from my last Annual Report the reasons for selecting this particular area.

> "The field for soil work in Malaya is virgin to an exceptionally and embarrassing degree, not only have no systematic investigations hitherto been carried out, but as far as the rolling or hilly inland soils (the back-bone of the country) are concerned there is absolutely no information as to their cultural characteristics which could be used as a basis for research. The reason for this is that our only inland large scale crop, rubber, is remarkably tolerant of a wide range of soil conditions and that manuring of rubber has never been practised. The most urgent problem appeared to be that of systematics, viz. the establishment of soil types and the relating of these types to the underlying parent material."

"*Soil types*:—To characterise types it was decided to carry out a soil survey of a limited and accessible area. The area selected was a strip in Selangor running from Cheras, through Serdang along the Klang valley to the Coast. This area has the advantage of including all the important geological formations on the west side of the Peninsula and also of including the Government large scale experimental plantation at Serdang."

It was clearly necessary to select an accessible area for an extremely detailed survey: from this detailed survey it was hoped that deductions could be drawn which would very greatly simplify the task of surveying or predicting the properties of areas on a geological formation of known type.

At end of the year the survey had reached the low-lying areas around Klang and had been slowed down considerably by unfavourable weather conditions.

426 samples representing 111 profiles were taken, the pH estimation and mechanical analysis completed. 268 of these samples were examined for the silica/sesquioxide ratio.

Subject to confirmation by sampling a number of similar geological areas in different parts of Malaya it seems possible to say that soils formed from "quartzite" are deep and sandy with not infrequent beds of shale and sometimes thin layers of "laterite." Peaty formations are common in broad valleys. These soils readily become compacted in spite of the high percentage of sand.

The Raub series (Phyllites) produce the soil usually known as 'laterite' containing a fairly high percentage of 'clay' and much concretionery gravel, and in general a marked 'crumb' structure.

The granite produces usually a permeable soil, consisting chiefly of coarse sand and clay.

The calcareous areas have not yet been investigated; and no simple relationships have been found for alluvial soils in the area under survey.

Padi Soils.—517 more samples were received from the Field Division; all have been subjected to mechanical analysis and pH determination.

Results confirm the opinion expressed in my last report that a fairly high percentage of sand is not necessarily a bar to good production; this may be seen from the following table, which shows the number of samples falling within each class.

% Sand 0—20	21—40	41—60	61—80	Yield in Gantangs
4	4	3	1	0— 80
5	13	10	4	81—180
11	21	19	10	181—280
9	23	24	5	281—380
5	12	11	3	381—480
3	1	3	—	481—

It seems to follow this that an area otherwise suitable, especially as regards water and population, need not be rejected for padi growing merely because of a somewhat high sand content.

Analysis of 100 of these soils for phosphorus content, (total, available and in fine fractions), acidity, percentage organic matter, and ammonification when flooded have yielded no correlations. This although disappointing is perhaps not surprising in view of the very large number of factors which may cause yields to become lower than the soil is capable of producing—attacks by birds and animals, inadequate attention and most important of all, lack of water control.

These numerous interfering factors will probably make it impossible ever to obtain mathematical correlations, but should not interfere with the collection of information in a negative form such as that provided by the sand-yield table given above, it may for example be found that a low content of potash does not interfere with good yield, etc.

Talang Experimental Station.—Mechanical analysis of 86 soil samples were carried out for the Agricultural Field Officer, Perak North of soil from this Station to ascertain the degree of the variability. In addition total and available

phosphorus was determined on the manurial plots—and it is interesting to note that while total P_2O_5 showed no significant increase even on the plots which had received phosphatic manures for 10 years, the citric soluble (available) P_2O_5 gave very clear increases on these plots.

Padi Tanks—Fifty experimental tanks $6' \times 4'$ completely enclosed by wire netting and with pumping plant and reservoir were constructed at Serdang Experimental Plantation in the latter half of the year. I have to express my best thanks to Mr. T. D. Marsh, Assistant Agriculturist, who took charge of this work. In these tanks all soil and water conditions will be capable of strict control.

Manurial Experiments.—A preliminary series of pot culture experiments on the three types of inland soil mentioned above which for convenience may be called the quartzite, laterite and granite, were carried out with Ragi. There were 100 pots for each type of soil and the experiment was laid out to test the effect of added nitrogen, phosphorus, potash in artificials alone and in combination, farmyard manure (as a standard and not as a practicable proposition), green manure with small quantities of artificials—calcium and sulphur, all the above with lime, lime alone and controls. There was considerable mortality in the early stages and yield variation from pot to pot, but even after discounting these adverse factors it clearly emerges that phosphorus is essential for successful growth and that (in these cultures) added potash was not required. Nitrogen with potash gave increased yields only on the quartzite. Lime alone showed no significant difference while it was harmful in conjunction with complete artificials. Cow dung and green manure with a small amount of artificials gave excellent results, green manures alone only small increases, while the best results were obtained by lime with cowdung—which in conjunction of the failure of lime with artificials suggests a bacteriological problem. The conclusions reached will be tested in the field in 1929; but even these very preliminary experiments suggest very strongly that when attention is turned to crops other than relatively slow growing trees such as rubber, the inland soils of Malaya will not be found to possess any peculiar properties of richness exempting them from the world-wide need for manuring in some form or other.

Percolation Experiments.—A number of large pots holding about 23 kilos of soil were set up for percolation experiments, half with 'quartzite' and half with laterite soil. These were treated with lime in varying quantities, different forms of nitrogenous manures—ammonium sulphite, urea, calcium cyanamide, ammonium phosphate, potassium nitrate, and a heavy dressing of grass turned under; the percolate was analysed for nitrate nitrogen. Results shewed that nitrification was somewhat slow in both soils but otherwise according to expectation—alternate plots were then planted with grass and in every case the nitrate in the percolate from the grassed pots dropped practically to zero and remained there. This raises interesting speculations as to the wisdom of heavy grass covers for growing crops. It was further found that the acidity of the percolate was directly proportional to the quantity of nitrate present. This supports the opinion expressed in my last report that the discrepancy below the pH value of suspensions and filtrates (ratio soil : water, 1 : 2) is due to the absence of soluble anions to act as carriers of the hydrogen ion.

Methods of Analysis.

1. Work on the estimation of phosphorus by a modified Denigès method was completed.

2. A considerable time was devoted to the study of different methods of base exchange. None proved entirely satisfactory in view of the extremely low base content of most Malayan soils, work is proceeding.

3. The molybdate colorimetric method for silica was studied and work is being conducted on a rapid method of arriving at the sesquioxide content by precipitation with phosphate.

4. The cobaltinitrite method for potash is being studied.

5. The Bouyoucos hydrometer method of soil analysis was examined and found sufficiently accurate for much of our work.

Cover Crops.

A certain number of leguminous covers were successfully grown in sand culture without nitrogen, resulting in the

formation of numerous nodules, these were used to inoculate seed planted at Serdang and the resultant crop showed a distinct increase of inoculated over the uninoculated plots. This work will be extended.

Miscellaneous.

1. The pot experiments on the use of sulphur for amelioration of heavy soils did not give positive results.
2. The soil of certain well defined and extensive infertile patches on two adjacent coconut estates is under examination.

Routine Analysis.

292 samples were examined for officers of this and other Departments and for the Public.

General.

Work mentioned in my last report and not in this has been temporarily held up for more urgent problems.

Publications.

Soil Analyses and their limitations, by W. N. C. Belgrave. (M.A.J. August, 1928, Vol. XVI).

The Colorimetric estimation of phosphorus in acid soil extracts, by W. N. C. Belgrave. (M.A.J. November, 1928. Vol. XVI).

An improved method of fusion for soils, by J. H. Dennett. (M.A.J. November, 1928, Vol. XVI).

A comparison of the Robinson, International and Bouyoucos methods of mechanical analysis on non-organic soils and the analysis of such soil with and without preliminary treatment with hydrogen peroxide, by J. H. Dennett. (M.A.J. November, 1928, Vol. XVI).

(Sd.) W. N. C. Belgrave,
Plant Physiologist, F.M.S. & S.S.

Kuala Lumpur,
28th January, 1929.

Agricultural Instructor (Malay Officers).

ANNUAL REPORT FOR 1928.

1. STAFF.

Raja Musa bin Raja Mahadi, Junior Agricultural Assistant, was transferred to the Co-operative Societies Department on 1st March, 1928, and was succeeded on 1st May by Enche Din bin Embi.

2. MALAY APPRENTICES.

22 Malay Apprentices were in course of training at the commencement of the year, as follows :—

	F.M.S.	S.S.	Johore.	Kedah.	Total.
1st Year Students ...	7	2	3	1	13
2nd Year Students ...	7	2	nil	nil	9
	14	4	3	1	22

The Apprenticeship of 5 Students (4 F.M.S. + 1 Johore) was terminated in April, 1928.

15 Malay Apprentices were appointed and commenced their training in May; they were recruited as follows:—

F.M.S.	S.S.	Johore.	Kedah.	Kelantan.
9	1	3	1	1

Of the newly appointed Apprentices, one developed consumption in September, and was granted extended sick leave without pay until March, 1929.

The Strength of the School at the end of the year was therefore as follows (omitting the Apprentice on leave):—

	F.M.S.	S.S.	Johore.	Kedah.	Kelantan.	Total.
1st Year Students ...	8	1	3	1	1	14
2nd Year Students ...	6	2	2	1	—	11
	14	3	5	2	1	25

3. Training.

Three terms were held during the year, as follows:—

	Working days.
3rd Term : 25th January to 14th April ...	65
1st Term : 14th May to 31st July ...	65
2nd Term : 3rd Sept. to 21st Dec. ...	92
Total ...	222

Lectures were given throughout by the Agricultural Instructor (Malay Officers) and the Assistant Agricultural Instructor.

Visits were paid to the Government Experimental Plantations, Serdang and elsewhere at intervals during the year; while the Agricultural Instructor accompanied the 2nd Year Students on a Field Tour from 12th to 21st March, inclusive, visiting estates and experiment stations of interest.

Practical gardening was included in the work of the 1st Year Students throughout the year, while 2nd Year Students underwent a course of instruction in Typewriting from May to July at the Evening Classes in Gombak Lane. One hour a week was devoted to Lectures and Debates, organised by the Students themselves.

The annual examinations were held in April. Of 9 2nd Year Students, 6 were successful, and were promoted to Junior Agricultural Assistants, being posted to divisions as follows:—

Field Division ...	3 (1 F.M.S. & 2 S.S.)
Economic Botanist ...	1
Plant Physiologist ...	1
Agricultural Instructor (M.O.)	1

Of 13 1st Year Students, 11 were promoted to the 2nd Year class. The apprenticeship of the remaining 3 2nd Year and 2 1st Year Students was terminated.

The 15 Apprentices newly appointed in May entered the 1st Year Class. These students come under the revised Scheme for Malay Officers, and therefore study for three years instead of two. The syllabus of instruction in the 1st

Year Class was therefore modified in order that the necessary groundwork be taken more thoroughly.

4. Health.

The health of the Malay Apprentices was satisfactory throughout the year, there being a conspicuous reduction in the amount of fever. One student unfortunately contracted tuberculosis, and was in hospital for some weeks; following a Medical Board in October, he was granted extended sick-leave without pay and was still absent at the end of the year.

5. Discipline.

The discipline of the students was satisfactorily maintained.

6. Promotion of Junior Agricultural Assistants.

Three examinations for Junior Agricultural Assistants to qualify for promotion to the rank of Senior Agricultural Assistant were arranged during the year; only one of five candidates satisfied the examiners. A Kedah agricultural officer was similarly examined in January, 1928.

7. School of Agriculture, Malaya.

The site selected for the School of Agriculture at Serdang was kept in clean condition, and boundary drains were improved during the year. A site for the Principal's quarters was levelled, and an access road thereto was commenced.

It was decided that the building of the School should be undertaken by the Public Works Department, which submitted new plans in December. Sums of $75,000 and $20,000 have been entered in the 1929 Estimates of the F.M.S. and S.S. Governments respectively as first votes for this enterprise.

Proposals were submitted, and were under consideration at the end of the year, for lighting and water supplies

at Serdang as joint schemes for the School and the Experimental Plantation.

The Advisory Committee for the School held a meeting on 19th December, 1928.

The offer of a Scholarship, to be called the "Edwin Philips Scholarship" was gratefully accepted.

8. Malay Officers Training Committee.

This Committee met twice during the year, on 10th February and 15th November.

9. Malay Officers Conference.

A Conference of Malay Officers was held at Headquarters from 26th to 28th January inclusive.

10. Publications.

The Agricultural Instructor (M.O.) issued the first two of a series of Instruction Manuals for Malay Officers towards the end of the year, as follows:—

(a) Introduction to Genetics

(b) Agricultural Economics.

The Assistant Agricultural Instructor assisted in the publication of the "Warta Perusahaan Tanah", to which he also contributed an article on Plant Propagation.

11. General.

The Agricultural Instructor (M.O.) served as Joint Honorary Organising Secretary of the Malayan Agri-Horticultural Association throughout the year.

The popularity of the Selangor Malayan Volunteer Infantry in this division was well maintained, the Agricultural Instructor, Junior Agricultural Assistant and 20 Malay Apprentices attending the Annual Camp at Port Dickson in August.

The Agricultural Department Football Club was converted into a Sports Club early in the year, and devoted its attentions mainly to Badminton, at which a successful tournament was held in December.

G. E. Mann,

Agricultural Instructor, (M.O.)

F.M.S. & S.S.

Kuala Lumpur,

5th January, 1929.